

Summary Results of 2017 Acoustic Monitoring

Great Lakes Inventory and Monitoring Network

Prepared for

National Park Service
Great Lakes Inventory and Monitoring Network
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1 Introduction

Normandeau Associates Inc. (Normandeau) was tasked with creating a streamlined automated Microsoft Access-based data management system for importing and summarizing the results of automatic identification of bat species and audio files for nine parks within the Great Lakes Inventory and Monitoring Network (GLKN). The management system involved quality checking (QC) the audio files, organizing them by park, sampling site and date, performing automatic identification (AutoID) of the audio files, importing the results of the AutoID, performing a manual identification of a subset of audio files, and importing the results of the manual ID. Finally, Normandeau was tasked with summarizing the AutoID results and performing some basic statistics.

This report summarizes the results of 2017 data collection and analysis of the AutoID and manual ID along with some additional supporting statistics about the number of audio files collected.

This report is organized into the following sections:

- Audio File Inventory Summary: lists the number of audio files for each park and the results of initial processing and organizing (before automatic identification)
- Deployment Summary: summarizes the number of deployments and deployment-nights per park
- AutoID Summary: summarizes the results of the automatic identification
- Manual Vetting Summary: summarizes the comparison of manual identifications to the automatic identifications
- Appendix: lists some tables too long for the report main body
- Supplementary Documents: lists the documents that have more detailed information about some aspects of the data processing and documents with tables too large for this report

The results in this summary report are presented, in general, by park. Presenting the results by each site/deployment within a park is generally not very informative due to the large number of sites/deployments within each park. Tables of summary statistics for individual sites/deployments will be provided in supplementary documents.

Table 1 lists the parks where the data were collected for the 2017 season along with the abbreviations used through this report for those parks.

Table 1-1. Parks where acoustic monitoring was performed during the 2017 monitoring season

Abbreviation	Name	State
INDU	Indiana Dunes National Lakeshore	IN
MISS	Mississippi National River and Recreation Area	MN
SACN	Saint Croix National Scenic Riverway	WI/MN
SLBE	Sleeping Bear Dunes National Lakeshore	MI
PIRO	Pictured Rocks National Lakeshore	MI
APIS	Apostle Islands National Lakeshore	WI
ISRO	Isle Royale National Park	MI
GRPO	Grand Portage National Monument	MN
VOYA	Voyageurs National Park	MN

NOTE: for all tables and graphs in this report, the parks are ordered from southern-most to northern-most.

The report is not intended to be high-level analysis of the resulting data. Instead, it is intended to be a very basic summary of the numbers and species of bat calls at various parks, as determined by the AutoID. In addition it provides a basic analysis of the validity of automatic identification as compared to manual identification. More advanced statistical comparison and detailed analysis is outside of the scope of this report.

Raw Data Provided:

The raw data provided by the National Park Service (NPS) for this analysis are audio files (sound recording in WAV file format). These audio files were organized into folders by location (park, site within park). In addition, the name of the audio file contained the date and time of its recording, allowing for the files to be further organized by date.

The National Park Service also supplied an initial Access database (Microsoft Access 2010) which was expanded upon to include the information extracted from the supplied audio files.

2 Audio File Inventory Summary

This section presents the results of the initial audio file processing, done before the files were run through an automatic classifier.

A thorough, detailed account of the data processing methods and settings is given in a separate document: the “Data Management Plan.”

The audio files were organized into folders by location (park, site within park). The name of the audio file contained the date and time of its recording, allowing for the files to be further organized by date. **For these results the recording “date” extends from the evening (after 5:00PM) of the actual date through the following morning (before noon).** Any files recorded after 5:00PM have the same date as the recording date, while any files recorded before noon have the previous day’s date.

- File recorded at 7:00PM on 6/2 has “Date” value of 6/2
- File recorded at 7:00AM on 6/2 has “Date” value of 6/1

Also during this process every audio file was analyzed by the SoX program to determine that the file was in fact an audio file, was not corrupted, and to optionally extract file parameters such as duration and number of channels. The audio file inventory and the results of the initial audio file processing were not stored in the original NPS Access database, but were instead stored in a supplementary table created by Normandeau.

The numbers of audio files for the 2017 recording period are listed in Table 2-1. The same data in terms of percent are shown in Table 2-2. The column “Total” lists the total number of audio files collected for each park. The remaining columns show how the audio files were classified for analysis.

Analyzed Files

- **Analyzed Summer:** If at least 4 days of the deployment occurred in the range 6/1-8/15, all files for that deployment were classified as summer season files and analyzed

Excluded from analysis:

- **Spring & Fall:** If less than 4 days of the deployment occurred in the range 6/1-8/15, all the files for that deployment were classified as either spring or fall
- **Short Deployment (Summer):** If a deployment was < 4 days total, no files were analyzed from that deployment
- **Extra Night (Summer):** If a deployment had > 16 nights, the files in the nights beyond 16 were not analyzed
- **Short Night (Summer):** Nights with recording time < 6 hours were not analyzed

Table 2-1. Audio file classification for analysis for 2017: Numbers of Files

Park	Total	Summer	Spring	Fall	Short Deploy ¹	Extra Night ²	Short Night ³
INDU	111729	111416	0	0	313	0	0
MISS	110486	86531	11955	0	0	11953	47
SACN	59788	57933	1082	773	0	0	0
SLBE	58279	58279	0	0	0	0	0
PIRO	119627	84465	21072	13334	733	23	0
APIS	22317	21829	0	0	487	0	1
ISRO	5709	5581	0	95	31	0	2
GRPO	9294	9266	0	0	0	0	28
VOYA	19288	19261	0	0	0	0	27
Total	516517	454561	34109	14202	1564	11976	105

¹ Deployment < 4 days² Files in nights beyond 16 nights³ Recording time < 6 hours

Table 2-2. Audio file classification for analysis for 2017: Percent of Files.

Park	Total	Summer	Spring	Fall	Short Deploy	Extra Night	Short Night
INDU	100	100	0	0	~0	0	0
MISS	100	78	11	0	0	11	~0
SACN	100	97	2	1	0	0	0
SLBE	100	100	0	0	0	0	0
PIRO	100	71	18	11	1	~0	0
APIS	100	98	0	0	2	0	~0
ISRO	100	98	0	2	1	0	~0
GRPO	100	100	0	0	0	0	~0
VOYA	100	100	0	0	0	0	~0
Total	100	88	7	3	~0	2	~0

Note: In tables displaying percentages, values sometimes appear not sum to 100% due to the displayed precision.

3 Deployment Summary

3.1.1 Deployments

Within each park, detectors were deployed at a given location (site) for a given length of time. A ‘deployment’ is defined as the site combined with time period the detector was deployed.

Table 3-1 lists the number of deployments per season as well the number of short deployments for each park. Figure 3-1 graphically depicts the number of deployments by season. Almost all deployments were in the summer season but for MISS and PIRO parks there were a notable number of deployments in the spring. There were 1 or 2 short deployments for 4 of the parks. The number of deployments in the summer season ranged from as few as 18 for GRPO and VOYA to as many as 35 for SLBE.

Table 3-1. Deployments (Sites) By Park and Season

Park	Total	Summer	Spring	Fall	Short Deploy	Date Range
INDU	31	30	0	0	1	06/07-08/09
MISS	32	27	5	0	0	05/02-08/21
SACN	30	28	1	1	0	05/19-08/23
SLBE	35	35	0	0	0	05/31-08/09
PIRO	45	31	10	3	1	04/07-08/24
APIS	25	24	0	0	1	05/30-08/17
ISRO	29	26	0	1	2	06/08-08/23
GRPO	18	18	0	0	0	06/01-08/02
VOYA	18	18	0	0	0	06/07-08/06

¹ Short: deployments < 4 days, not analyzed

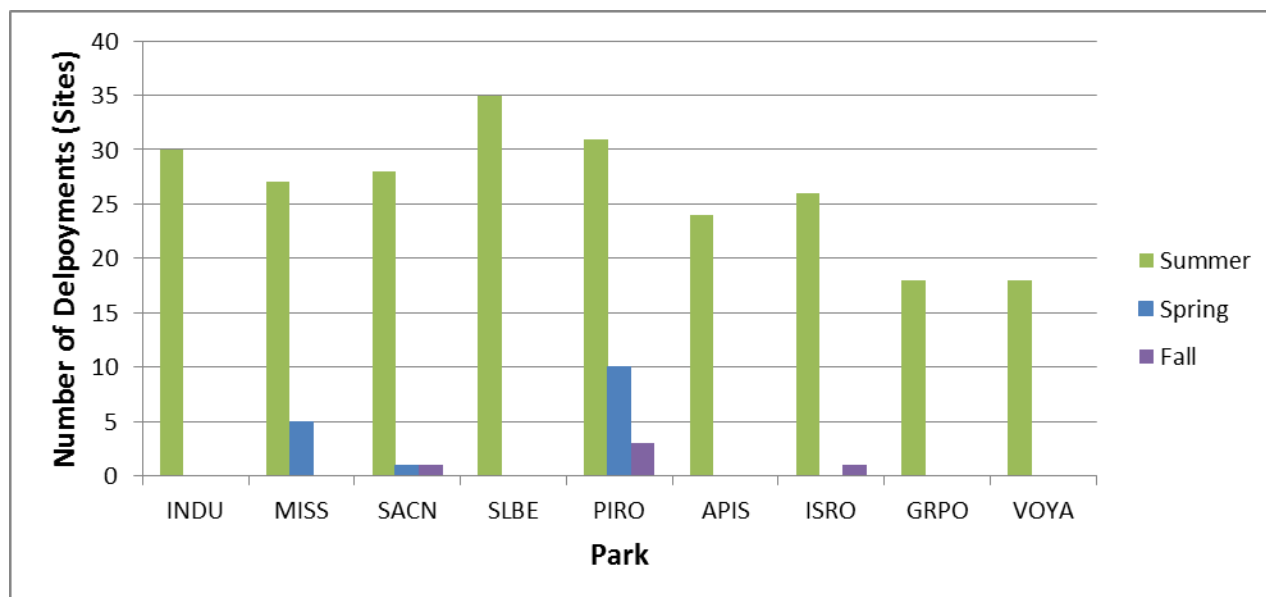


Figure 3-1. Deployments (Sites) By Park and Season

For the summer season (6/1-8/15), the number of deployments per day is shown in Figure 3-2. The table for this data is given in Appendix A because it is too big to show here. The dates shown in the figure that occur outside

of the summer range belong to deployments that are considered ‘summer deployments’. If a deployment had at least 4 days in the summer date range, then all dates of the deployment were analyzed as summer dates.

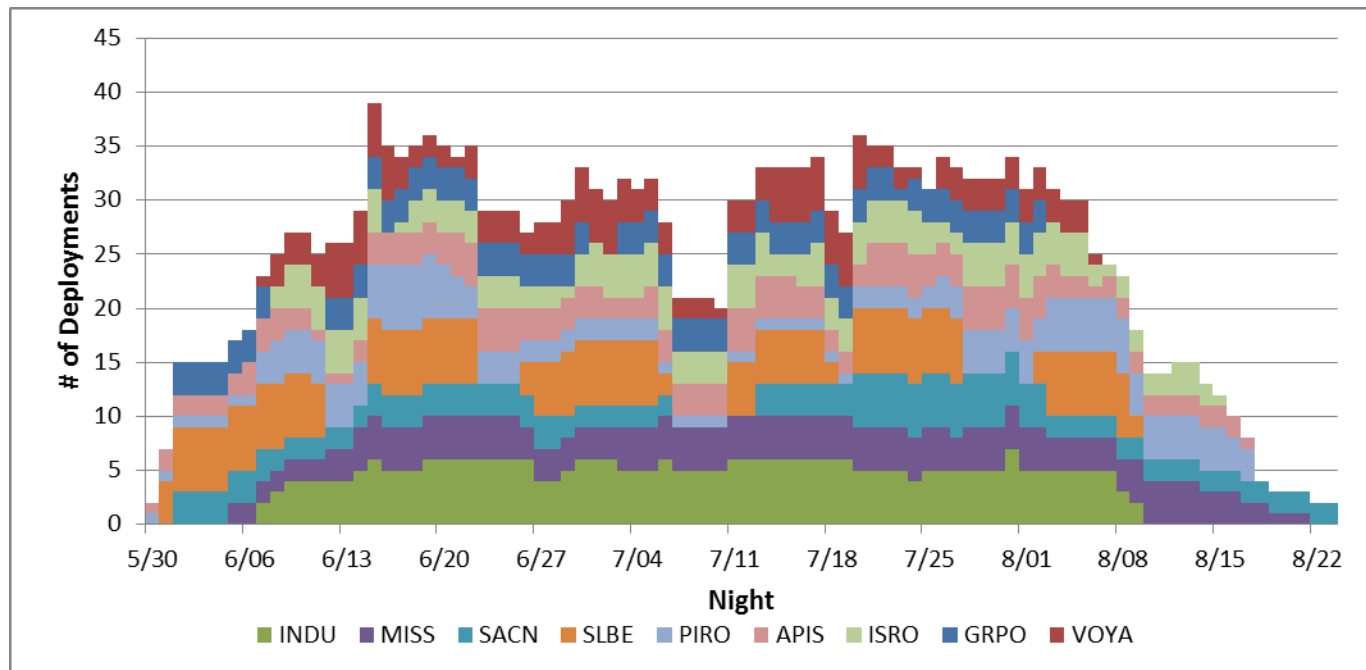


Figure 3-2. Number of Deployments by Date, during the Summer season

3.1.2 Deployment Nights

The number of ‘deployment-nights’ for a park is the sum of the number of nights for each deployment. For example if a park had 3 deployments of 11, 6 and 10 nights, the number of deployment-nights for that park is 27 (11+6+10). Even if the deployments overlap and occurred on many of the same nights, the number of deployment-nights is still 27. If a park has 3 deployments on the same night, that would be 3 deployment-nights not 1.

Table 3-2 lists and Figure 3-3 shows the deployment-nights for each park. A few notes about the night counts:

- Nights for deployments less than 4 days are NOT counted
- Nights beyond the 16th night for single deployment are NOT counted

This shows that almost all deployment-nights occurred during the summer season with MISS and PIRO having a notable number of deployment-nights in the spring.

Table 3-2. Deployment-Nights by Park and Season

Park	Summer	Spring	Fall
INDU	326	0	0
MISS	266	53	0
SACN	224	7	7
SLBE	300	0	0
PIRO	228	80	21
APIS	221	0	0
ISRO	213	0	9
GRPO	169	0	0
VOYA	193	0	0

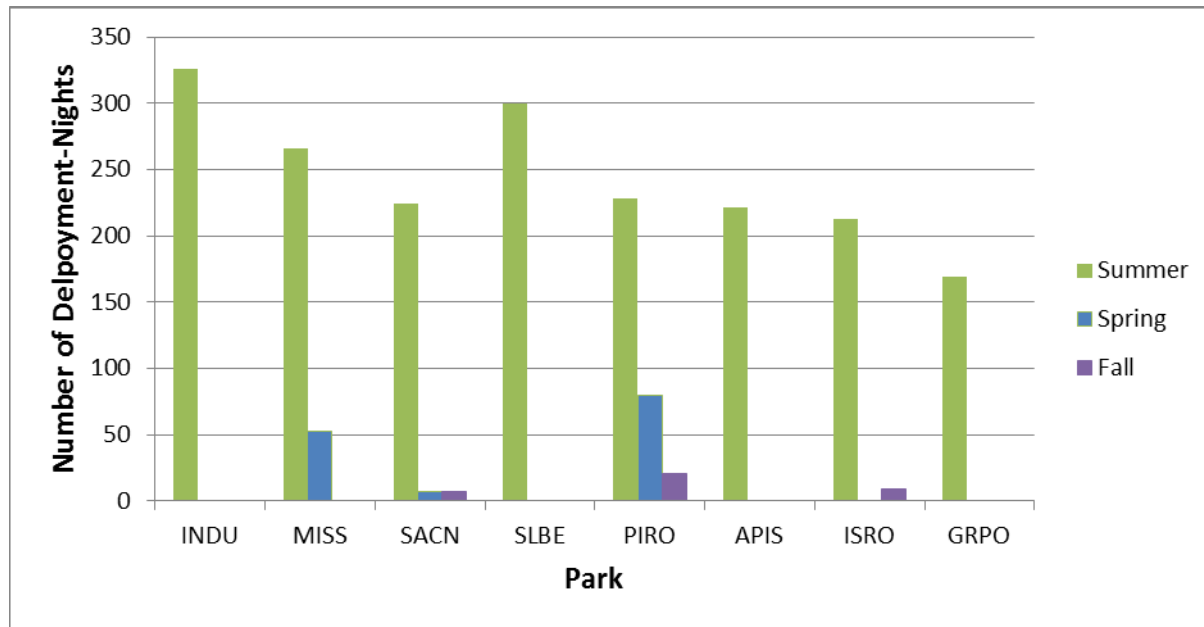


Figure 3-3. Deployment-Nights by Park and Season

4 Auto-ID Summary

The Wildlife Acoustics Kaleidoscope Pro software (KPro) version 4.0.0 was used to remove non-bat noise files and to identify all bats to species using a built in auto classifier. Guidelines for use of auto classifier programs defined in the USFWS 2017 Indiana bat summer survey protocol* were followed. KPro has three options for setting the sensitivity of the classifier: -1 More Sensitive (Liberal); 0 Balanced (Neutral), and +1 More Accurate (Conservative). For this analysis the “-1 More Sensitive (Liberal)” setting was used, as suggested in the USFWS guidelines.

First, full spectrum audio files were converted to zero-cross files. In this process KPro classified some files as ‘Noise’ and did not create a zero-cross file. Also a very small number of files (10 or less per park) experienced other various errors and were not converted to zero-cross.

Second, KPro was run again to analyze the zero-cross files and produce an identification (ID): either ‘Noise’, ‘NoID’ (unknown bat call), or a specific species ID.

The bat biologists assembled a list of possible bat species for each park, as shown in Table 4-1. Those were the only species, for that park, that KPro considered in the automatic identification. The baseline analysis includes only species that have been documented within each park’s boundaries. The expanded analysis includes species that have been documented within each park’s boundaries as well as species that have been reported in nearby areas.

From this point forward, the term “Auto ID”, refers to the automatic identification of the audio file via the KPro program.

4.1 Species to be considered for Auto ID

The following tables show the species that that KPro considered for each park. For the 2017 data, both a ‘baseline’ and an ‘expanded’ species analysis were done. Both analyses were done in the exact same manner, only changing the species KPro could consider in making an ID. Table 4-1 shows the species considered for Auto ID in the baseline (●) and the expanded (✱) analyses.

* U.S. Fish and Wildlife Service (USFWS). 2017. Range-wide Indiana Bat Summer Survey Guidelines. April 2017.
<www.fws.gov/midwest/Endangered/mammals/inba/surveys/pdf/2017IndianaBatSummerSurveyGuidelines11April2017.pdf>

Table 4-1. Bat Species considered by KPro analysis, for each Park

Park	EPFU ¹	LABO	LACI	LANO	MYLU	MYSE	MYSO	NYHU	PESU
INDU	●	●	●	●	●	●	●	●	●
MISS	●	●	●	●	●	●		❄	●
SACN	●	●	●	●	●	●		❄	●
SLBE	●	●	●	●	●	●	❄		❄
PIRO	●	●	●	●	●	●			❄
APIS	●	●	●	●	●	●			❄
ISRO	●	●	●	●	●	●			❄
GRPO	●	●	●	●	●	●			❄
VOYA	●	●	●	●	●	●			❄

¹ See Table 4-2 for bat species abbreviations

● : baseline AutoID analysis

❄ : expanded AutoID analysis

Table 4-2. Bat species abbreviations used in this analysis

Abbreviation	Scientific Name	Common Name
EPFU	<i>Eptesicus fuscus</i>	Big Brown Bat
LABO	<i>Lasiurus borealis</i>	Eastern Red Bat
LACI	<i>Lasiurus cinereus</i>	Hoary Bat
LANO	<i>Lasionycteris noctivagans</i>	Silver-haired Bat
MYLU	<i>Myotis lucifugus</i>	Little Brown Bat
MYSE	<i>Myotis septentrionalis</i>	Northern Long-eared Bat
MYSO	<i>Myotis sodalis</i>	Indiana Bat
NYHU	<i>Nycticeius humeralis</i>	Evening Bat
PESU	<i>Perimyotis subflavus</i>	Tri-colored Bat

4.1.1 Calls vs. Noise

Table 4-3 shows the numbers of specific IDs compared to unknown bat calls and noise for the Summer season files analyzed using the baseline species analysis. The table columns show:

- Number of files analyzed (Audio Files)
- Number of files ID'd as a specific species (Species ID)
- Number of files ID'd as a bat but could not determine species (No Id)
- Number of files ID'd as Noise (includes files labeled as noise during the conversion from full spectrum to zero-cross)
- Files that KPro could not analyze (KPro fail)

A very small number of files could not be processed by KPro (KPro fail) for “corrupted header” and other cryptic reasons. Since it was such a small number of files, the reasons for these errors were not pursued further.

The last four columns of the table show the percentages of files for each general result. Generally, at least 80% of files were ID'd to species with almost all the rest of the files ID'd as Noise. Only a very small number of files were ID'd as unknown bat call sequences.

PIRO park had a very high percentage (87%) of noise files compared with the other parks.

Figure 4-1 and Figure 4-2 are plots of the data shown in Table 4-3.

Table 4-3. Number and Percent of Files By Park: Call Sequences vs. Noise, Summer Only, Baseline Analysis

Park	#Audio File	#Species Id	#No Id	#Noise	#KPro Fail ¹	%Species Id	%No Id	%Noise	%KPro Fail
INDU	111416	88090	1169	22155	2	79.1	1	19.9	~0
MISS	86531	76460	852	9164	55	88.4	1	10.6	0.1
SACN	57933	47750	708	9470	5	82.4	1.2	16.3	~0
SLBE	58279	50457	386	7403	33	86.6	0.7	12.7	0.1
PIRO	84465	9843	585	73839	198	11.7	0.7	87.4	0.2
APIS	21829	19890	123	1807	9	91.1	0.6	8.3	~0
ISRO	5581	4686	42	848	5	84	0.8	15.2	0.1
GRPO	9266	7946	99	1217	4	85.8	1.1	13.1	~0
VOYA	19261	17217	120	1918	6	89.4	0.6	10	~0
Total	454561	322339	4084	127821	317	70.9	0.9	28.1	~0

¹ Files that KPro could not process (sometimes bad header, sometimes for unknown reasons)

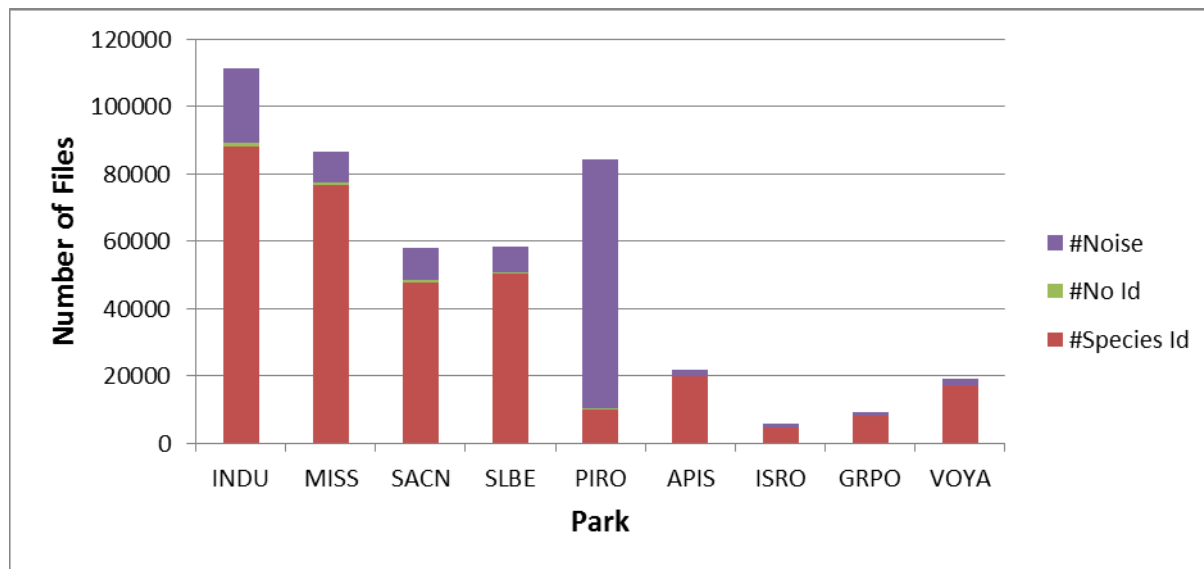


Figure 4-1. Number of Files By Park: Call Sequences vs. Noise, Summer Only, Baseline Analysis

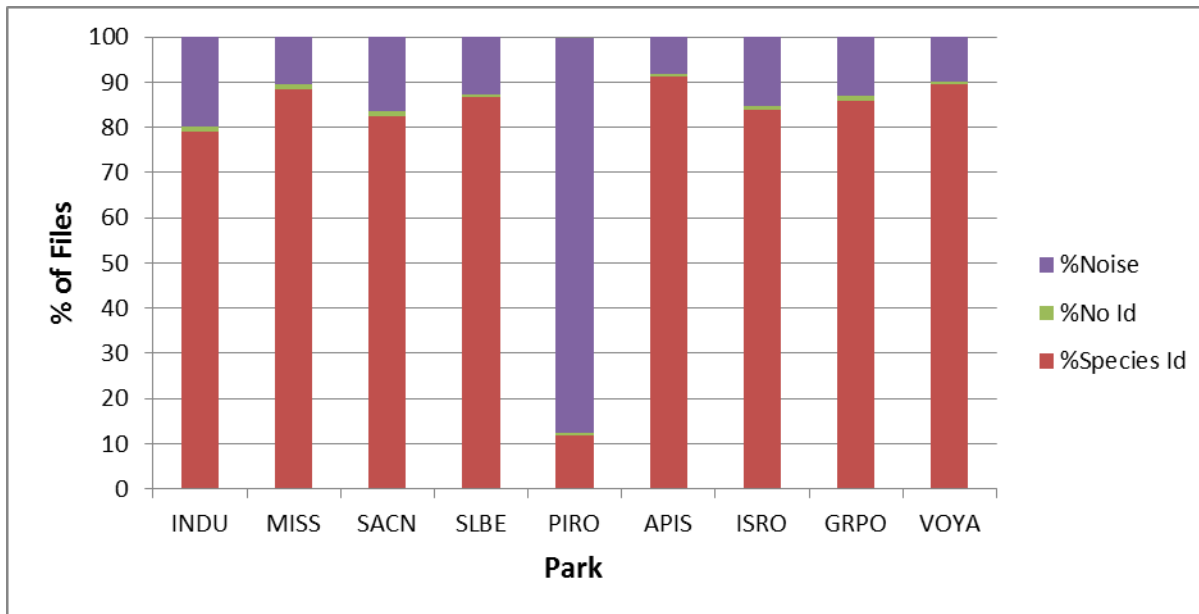


Figure 4-2. Percent of Files by Park: Call Sequences vs. Noise, Summer Only, Baseline Analysis

Table 4-4 shows the numbers of specific IDs compared to unknown bat call sequences and noise for the Summer season files analyzed using the expanded species analysis. Figure 4-3 and Figure 4-4 are plots of the data shown in Table 4-4. Compared to the baseline species analysis a small number of call sequences were reclassified as No Id, while the number of noise files stayed the same. Table 4-5 shows the difference between the expanded (Table 4-4) and baseline (Table 4-3) analysis results.

Table 4-4. Number and Percent of Files By Park: Call Sequences vs. Noise, Summer Only, Expanded Analysis

Park	#Audio File	#Species Id	#No Id	#Noise	#KPro Fail	%Species Id	%No Id	%Noise	%KPro Fail
INDU	111416	88090	1169	22155	2	79.1	1	19.9	~0
MISS	86531	76413	899	9164	55	88.3	1	10.6	0.1
SACN	57933	47602	856	9470	5	82.2	1.5	16.3	~0
SLBE	58279	50311	532	7403	33	86.3	0.9	12.7	0.1
PIRO	84465	9830	598	73839	198	11.6	0.7	87.4	0.2
APIS	21829	19848	165	1807	9	90.9	0.8	8.3	~0
ISRO	5581	4684	44	848	5	83.9	0.8	15.2	0.1
GRPO	9266	7941	104	1217	4	85.7	1.1	13.1	~0
VOYA	19261	17198	139	1918	6	89.3	0.7	10	~0
Total	454561	321917	4506	127821	317	70.8	1	28.1	~0

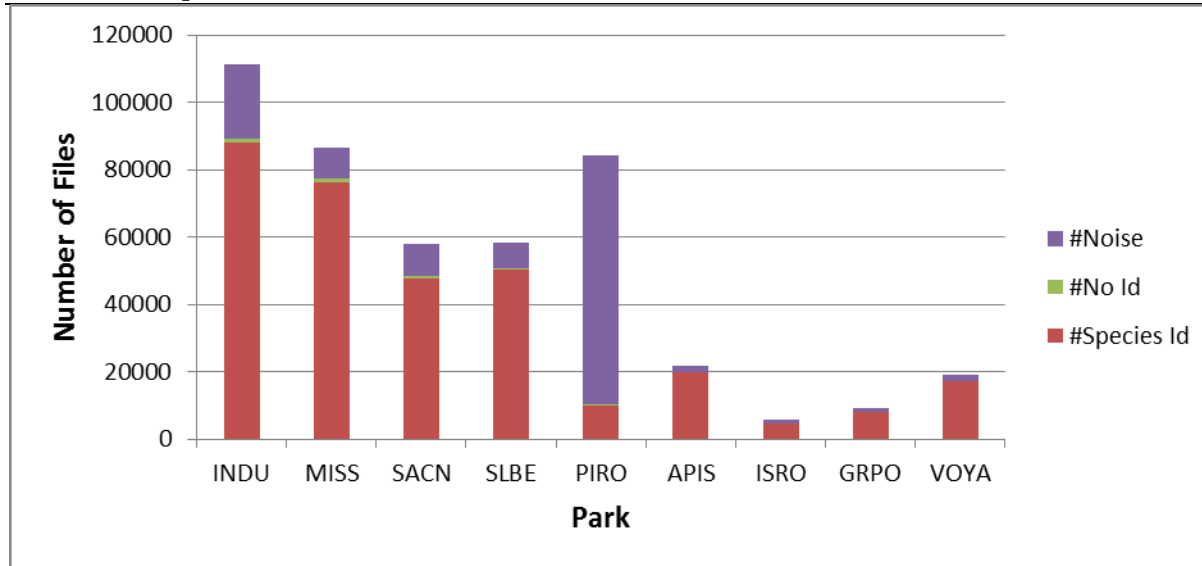


Figure 4-3. Number of Files By Park: Call Sequences vs. Noise, Summer Only, Expanded Analysis

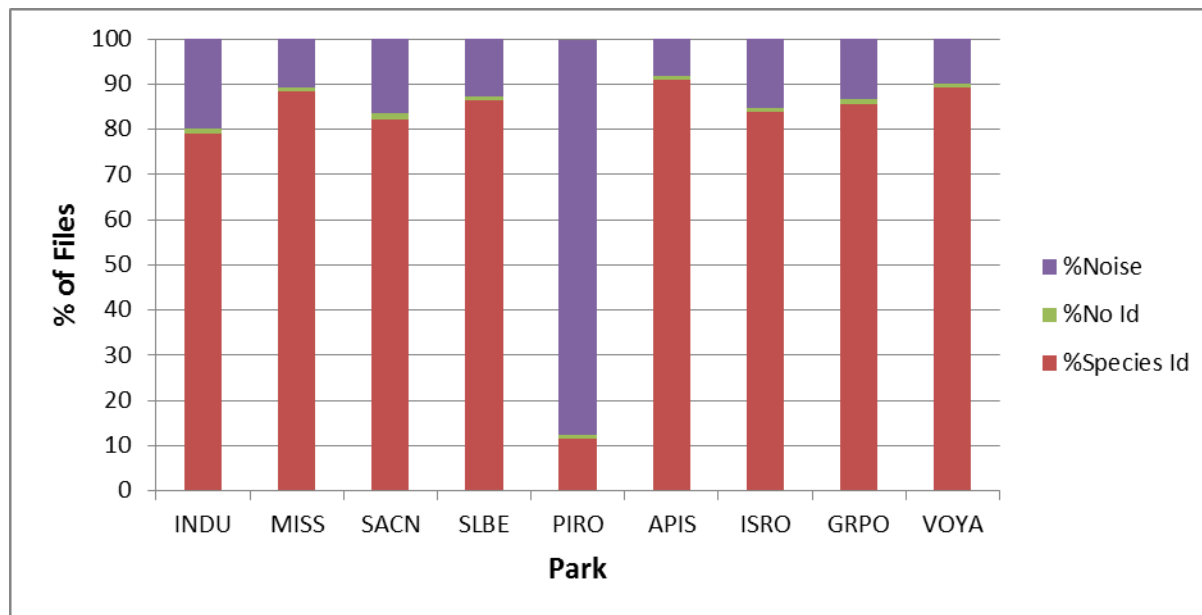


Figure 4-4. Percent of Files by Park: Call Sequences vs. Noise, Summer Only, Expanded Analysis

Table 4-5. Difference in Number and Percent of Files By Park: Call Sequences vs. Noise, Summer Only. Differences were calculated by subtracting Baseline Analysis values from Expanded Analysis values.

Park	#Audio File	#Species Id	#No Id	#Noise	#KPro Fail	%Species Id	%No Id	%Noise	%KPro Fail
INDU	0	0	0	0	0	0	0	0	0
MISS	0	-47	47	0	0	-0.1	0	0	0
SACN	0	-148	148	0	0	-0.2	0.3	0	0
SLBE	0	-146	146	0	0	-0.3	0.2	0	0
PIRO	0	-13	13	0	0	-0.1	0	0	0
APIS	0	-42	42	0	0	-0.2	0.2	0	0
ISRO	0	-2	2	0	0	-0.1	0	0	0
GRPO	0	-5	5	0	0	-0.1	0	0	0
VOYA	0	-19	19	0	0	-0.1	0.1	0	0
Total	0	-422	422	0	0	-0.1	0.1	0	0

4.1.2 Calls by Species

Table 4-6 shows the total number of files identified to each species by KPro (summer season only), using the baseline species analysis and Figure 4-5 graphs the table data.

Table 4-7 shows the total number of files identified to each species by KPro (summer season only), using the expanded species analysis and Figure 4-6 graphs the table data.

Table 4-8 shows the change in species ID from the baseline to the expanded species analysis.

Table 4-6. Number of Files AutoID'd to each Species by Park, Summer only, Baseline Analysis

Park	EPFU	LABO	LACI	LANO	MYLU	MYSE	MYSO	NYHU	PESU	All Species
INDU	43850	17887	7028	13226	1553	24	67	3922	533	88090
MISS	26261	5840	6579	8665	22610	2763	na	na	3742	76460
SACN	3978	9394	7691	14628	10949	238	na	na	872	47750
SLBE	10222	10873	7449	14100	7502	311	na	na	na	50457
PIRO	353	1055	2838	4745	763	89	na	na	na	9843
APIS	509	3979	1478	2953	10473	498	na	na	na	19890
ISRO	148	270	741	587	2702	238	na	na	na	4686
GRPO	269	860	1365	3763	1389	300	na	na	na	7946
VOYA	100	449	4239	1520	10138	771	na	na	na	17217
All Parks	85690	50607	39408	64187	68079	5232	67	3922	5147	322339

na: species was not considered in the analysis

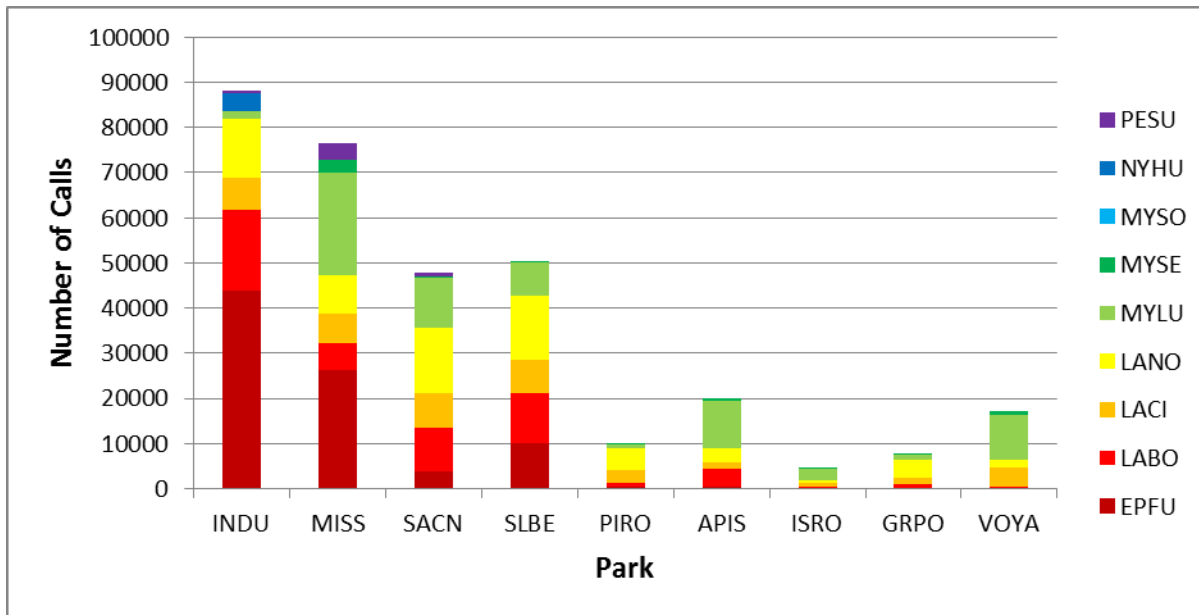


Figure 4-5. Number of Files AutoID'd to each Species by Park, Baseline Analysis

Table 4-7. Number of Files AutoID'd to each Species by Park, Summer only, Expanded Analysis

Park	EPFU	LABO	LACI	LANO	MYLU	MYSE	MYSO	NYHU	PESU	All Species
INDU	43850	17887	7028	13226	1553	24	67	3922	533	88090
MISS	26276	5484	6577	8659	22556	2757	na	364	3740	76413
SACN	3990	6312	7692	14633	10782	236	na	3139	818	47602
SLBE	10231	10270	7454	14119	6866	252	776	na	343	50311
PIRO	354	1004	2842	4746	767	90	na	na	27	9830
APIS	508	3689	1479	2953	10524	506	na	na	189	19848
ISRO	149	267	740	587	2692	239	na	na	10	4684
GRPO	269	842	1365	3764	1384	303	na	na	14	7941
VOYA	100	384	4240	1520	10167	774	na	na	13	17198
All Parks	85727	46139	39417	64207	67291	5181	843	7425	5687	321917

na: species was not considered in the analysis

Highlighted cells are species and park combinations added in the expanded analysis

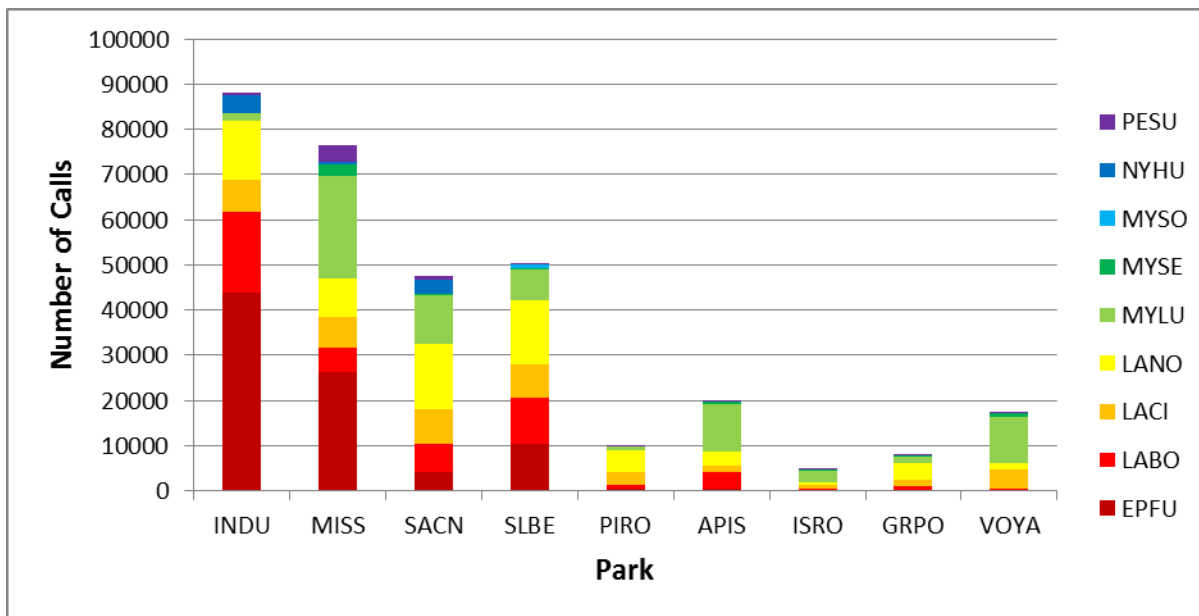


Figure 4-6. Number of Files AutoID'd to each Species by Park, Expanded Analysis

Table 4-8. Difference in Number of Files AutoID'd to each Species by Park, Summer only. Differences were calculated by subtracting Baseline Analysis values from Expanded Analysis values.

Park	EPFU	LABO	LACI	LANO	MYLU	MYSE	MYSO	NYHU	PESU	All Species
INDU	0	0	0	0	0	0	0	0	0	0
MISS	15	-356	-2	-6	-54	-6	na	364	-2	-47
SACN	12	-3082	1	5	-167	-2	na	3139	-54	-148
SLBE	9	-603	5	19	-636	-59	776	na	343	-146
PIRO	1	-51	4	1	4	1	na	na	27	-13
APIS	-1	-290	1	0	51	8	na	na	189	-42
ISRO	1	-3	-1	0	-10	1	na	na	10	-2
GRPO	0	-18	0	1	-5	3	na	na	14	-5
VOYA	0	-65	1	0	29	3	na	na	13	-19
Total	37	-4468	9	20	-788	-51	776	3503	540	-422

na: species was not considered in the analysis

Highlighted cells are species and park combinations added in the expanded analysis

Table 4-9 shows the number of files per deployment-night identified to each species by KPro (summer season only), using the baseline species analysis and Figure 4-7 graphs the table data.

Table 4-10 shows the number of files per deployment-night identified to each species by KPro (summer season only), using the expanded species analysis and Figure 4-8 graphs the table data.

Table 4-11 shows the change in species ID per deployment-night from the baseline to the expanded species analysis.

Table 4-9. Number of Files per Deployment-Night AutoID'd to each Species by Park, Summer Only, Baseline Analysis

Park	EPFU	LABO	LACI	LANO	MYLU	MYSE	MYSO	NYHU	PESU	All Species
INDU	134.5	54.9	21.6	40.6	4.8	0.1	0.2	12.0	1.6	270.2
MISS	98.7	22.0	24.7	32.6	85.0	10.4	na	na	14.1	287.4
SACN	17.8	41.9	34.3	65.3	48.9	1.1	na	na	3.9	213.2
SLBE	34.1	36.2	24.8	47.0	25.0	1.0	na	na	na	168.2
PIRO	1.5	4.6	12.4	20.8	3.3	0.4	na	na	na	43.2
APIS	2.3	18.0	6.7	13.4	47.4	2.3	na	na	na	90.0
ISRO	0.7	1.3	3.5	2.8	12.7	1.1	na	na	na	22.0
GRPO	1.6	5.1	8.1	22.3	8.2	1.8	na	na	na	47.0
VOYA	0.5	2.3	22.0	7.9	52.5	4.0	na	na	na	89.2
All Parks	40.0	23.6	18.4	30.0	31.8	2.4	0.2	12.0	6.3	150.6

na: species was not considered in the analysis

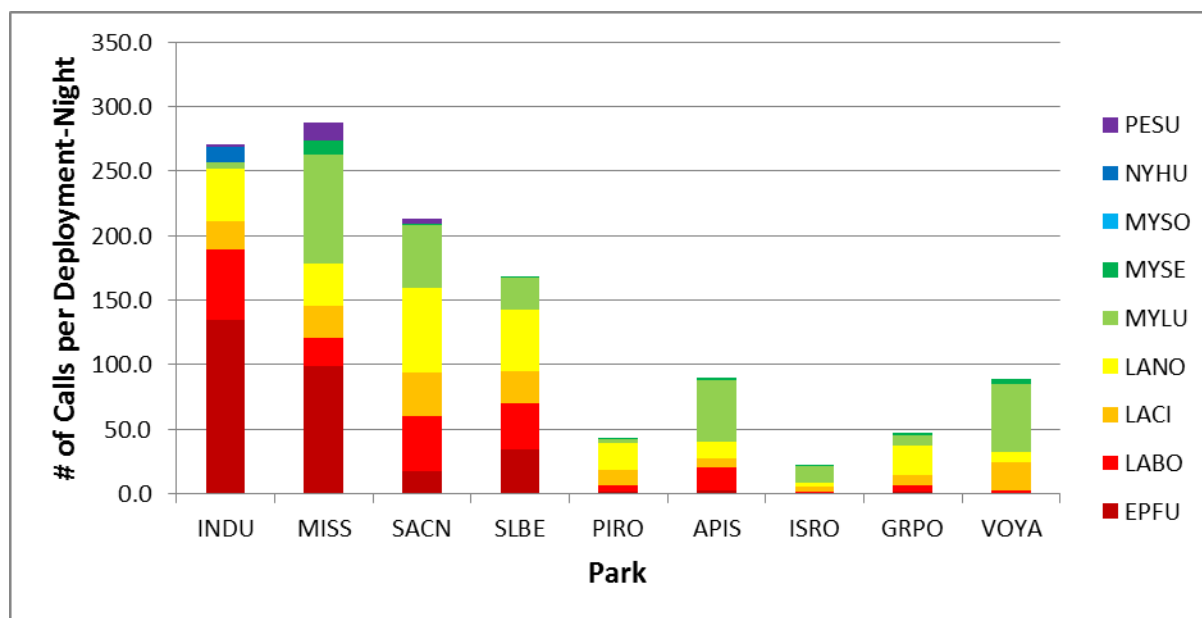


Figure 4-7. Number of Files per Deployment-Night AutoID'd to each Species by Park, Summer Only, Baseline Analysis

Table 4-10. Number of Files per Deployment-Night AutoID'd to each Species by Park, Summer Only, Expanded Analysis

Park	EPFU	LABO	LACI	LANO	MYLU	MYSE	MYSO	NYHU	PESU	All Species
INDU	134.5	54.9	21.6	40.6	4.8	0.1	0.2	12.0	1.6	270.2
MISS	98.8	20.6	24.7	32.6	84.8	10.4	na	1.4	14.1	287.3
SACN	17.8	28.2	34.3	65.3	48.1	1.1	na	14.0	3.7	212.5
SLBE	34.1	34.2	24.8	47.1	22.9	0.8	2.6	na	1.1	167.7
PIRO	1.6	4.4	12.5	20.8	3.4	0.4	na	na	0.1	43.1
APIS	2.3	16.7	6.7	13.4	47.6	2.3	na	na	0.9	89.8
ISRO	0.7	1.3	3.5	2.8	12.6	1.1	na	na	0.0	22.0
GRPO	1.6	5.0	8.1	22.3	8.2	1.8	na	na	0.1	47.0
VOYA	0.5	2.0	22.0	7.9	52.7	4.0	na	na	0.1	89.1
All Parks	40.1	21.6	18.4	30.0	31.4	2.4	1.3	9.1	2.7	150.4

na: species was not considered in the analysis

Highlighted cells are species and park combinations added in the expanded analysis

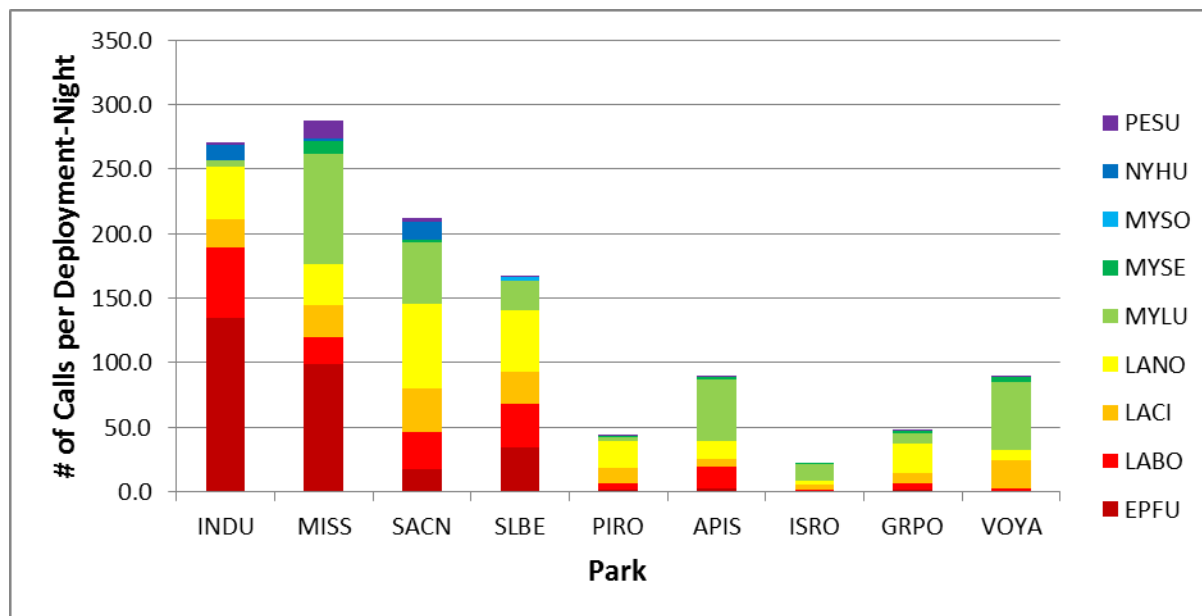


Figure 4-8. Number of Files per Deployment-Night AutoID'd to each Species by Park, Summer Only, Expanded Analysis

Table 4-11. Difference in Number of Files per Deployment-Night AutoID'd to each Species by Park, Summer Only. Differences were calculated by subtracting Baseline Analysis values from Expanded Analysis values.

Park	EPFU	LABO	LACI	LANO	MYLU	MYSE	MYSO	NYHU	PESU	All Species
INDU	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MISS	0.1	-1.4	0.0	0.0	-0.2	0.0	na	1.4	0	-0.1
SACN	0.0	-13.7	0.0	0.0	-0.8	0.0	na	14	-0.2	-0.7
SLBE	0.0	-2.0	0.0	0.1	-2.1	-0.2	2.6	na	1.1	-0.5
PIRO	0.1	-0.2	0.1	0.0	0.1	0.0	na	na	0.1	-0.1
APIS	0.0	-1.3	0.0	0.0	0.2	0.0	na	na	0.9	-0.2
ISRO	0.0	0.0	0.0	0.0	-0.1	0.0	na	na	0	0.0
GRPO	0.0	-0.1	0.0	0.0	0.0	0.0	na	na	0.1	0.0
VOYA	0.0	-0.3	0.0	0.0	0.2	0.0	na	na	0.1	-0.1
All Parks	0.1	-2.0	0.0	0.0	-0.4	0.0	1.1	-2.9	-3.6	-0.2

na: species was not considered in the analysis

Highlighted cells are species and park combinations added in the expanded analysis

4.1.3 Nightly Patterns of Activity

Figure 4-9 shows the total number of call sequences recorded for each date and species, for the baseline species analysis. This is the combined number of call sequences for all deployments in all parks on that date, during the summer season only.

Figure 4-10 shows the number of call sequences recorded per deployment-night for each date and species, for the baseline species analysis. Again this is for all parks combined and during the summer season only.

Figure 4-11 and Figure 4-12 show the total number of call sequences and call sequences per deployment-night, respectively, recorded for each date and species, for the expanded species analysis. This is for all parks combined.

Figure 4-13 and Figure 4-14 show the changes in species ID from the baseline to the expanded analysis for total number of call sequences and call sequences per deployment-night, respectively. This is for all parks combined.

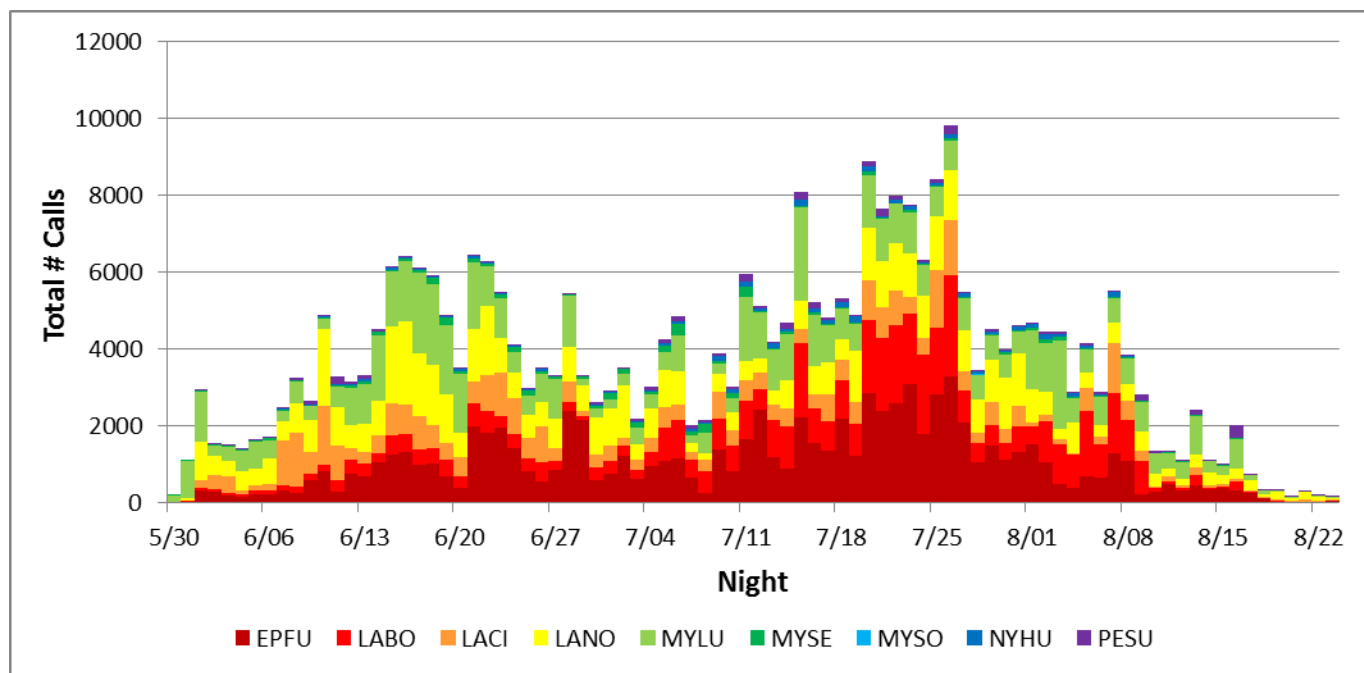


Figure 4-9. Total number of Call Sequences Recorded (All Parks Combined), for each Date and Species (Summer only), Baseline Analysis

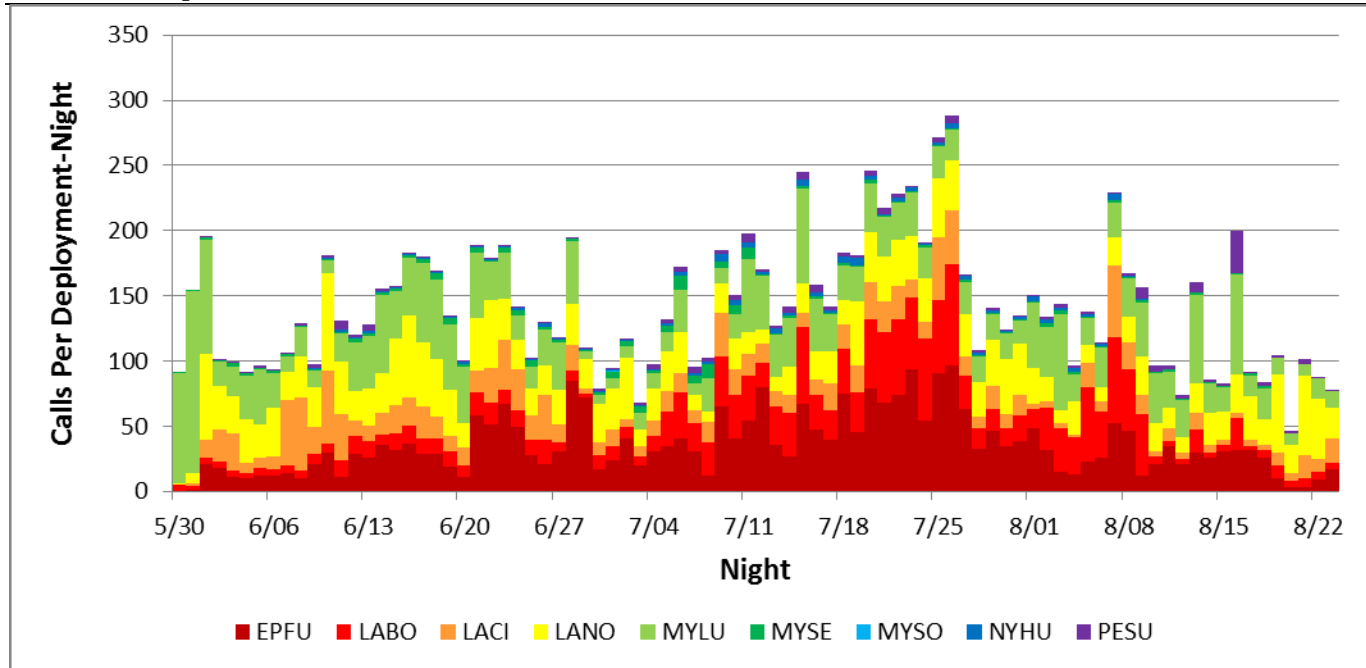


Figure 4-10. Number of Call Sequences Recorded per Deployment-Night (All Parks Combined), for each Date and Species (Summer only), Baseline Analysis

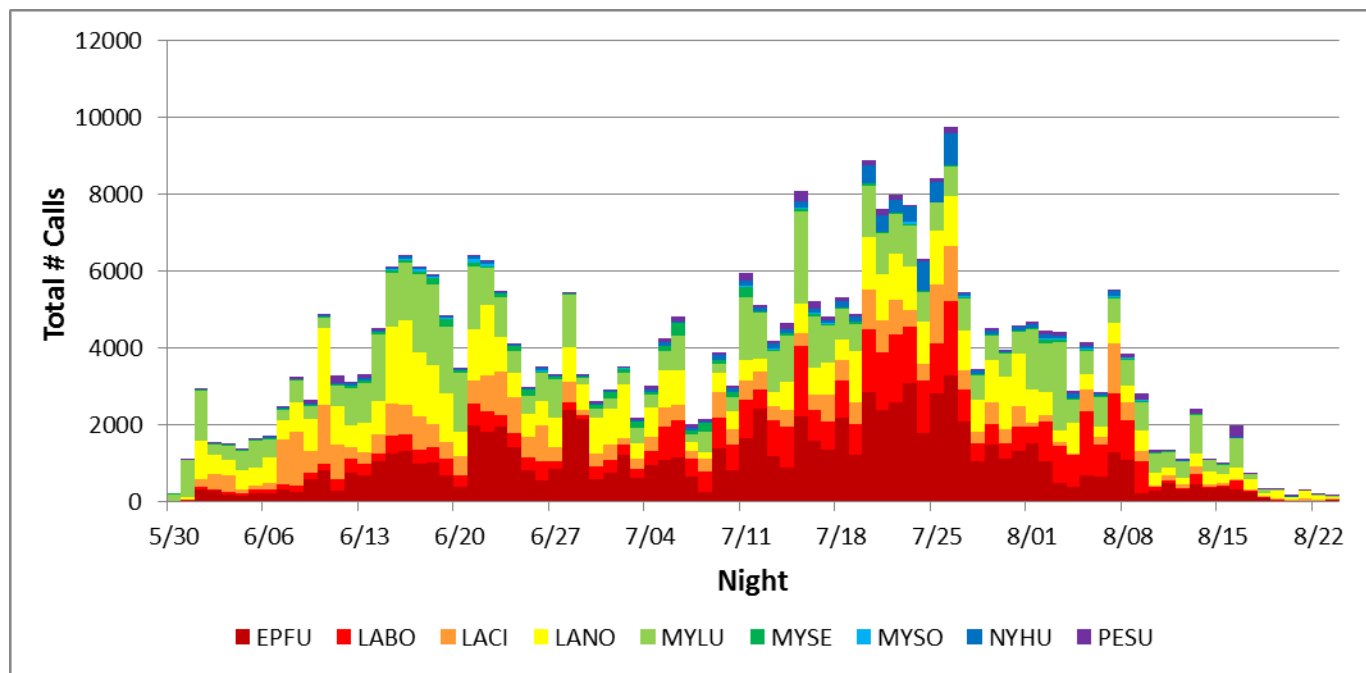


Figure 4-11. Total number of Call Sequences Recorded (All Parks Combined), for each Date and Species (Summer only), Expanded Analysis

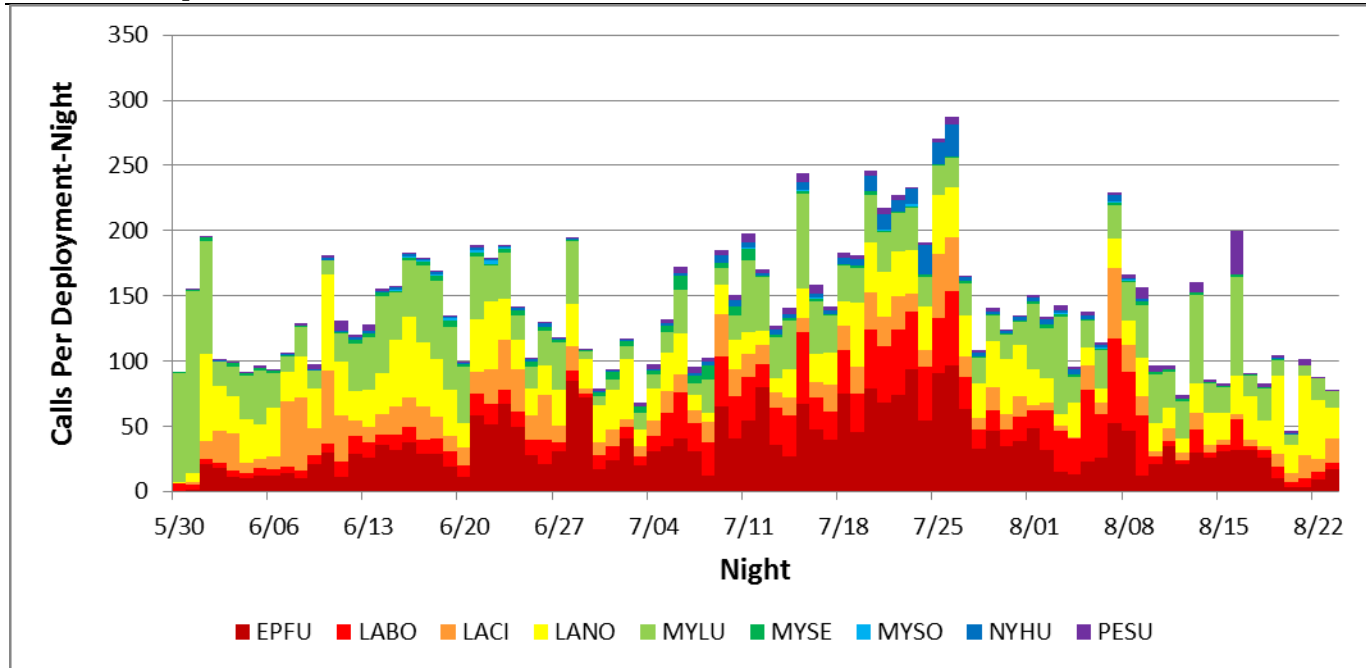


Figure 4-12 Number of Call Sequences Recorded per Deployment-Night (All Parks Combined), for each Date and Species (Summer only), Expanded Analysis

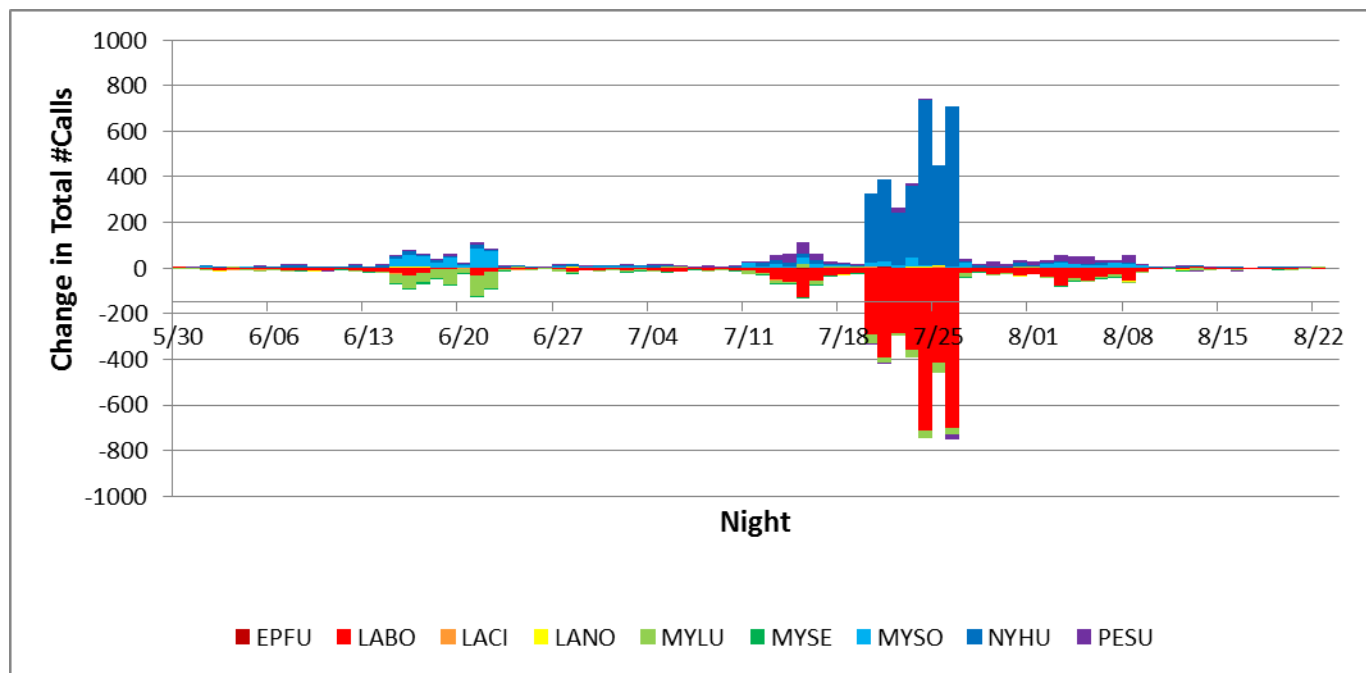


Figure 4-13. Difference in Total number of Call Sequences Recorded (All Parks Combined), for each Date and Species (Summer only. Differences were calculated by subtracting Baseline Analysis values from Expanded Analysis values.

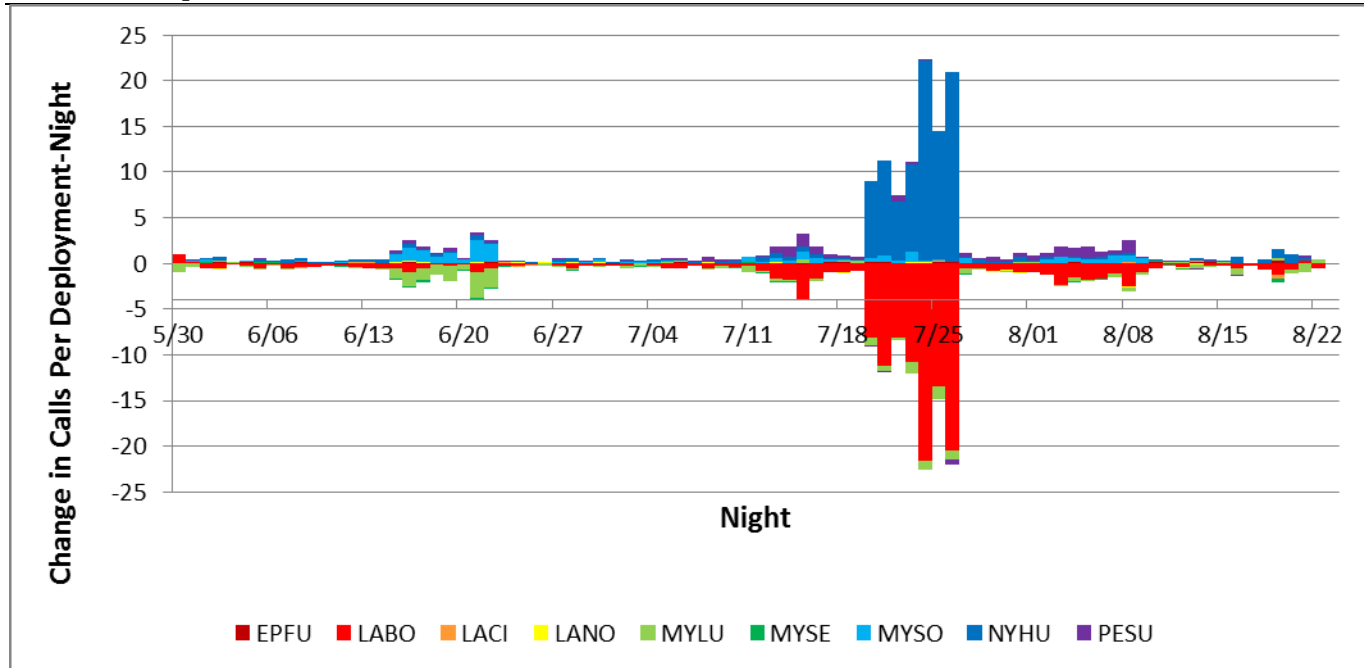


Figure 4-14. Difference in Number of Call Sequences Recorded per Deployment-Night (All Parks Combined), for each Date and Species (Summer only). Differences were calculated by subtracting Baseline Analysis values from Expanded Analysis values.

Figure 4-15 and Figure 4-16 show the total number of call sequences per night and the number of call sequences per deployment-night, respectively, for each date and park with all species combined. This helps illustrate the pattern of total bat activity.

Because the following graphs do not show individual species IDs, the graphs are essentially same for both the baseline and expanded analysis and therefore only one set of graphs is shown. (There would be very small differences due to the changes in ID from a particular species to No ID, but those differences are not apparent on the graphs due to scale).

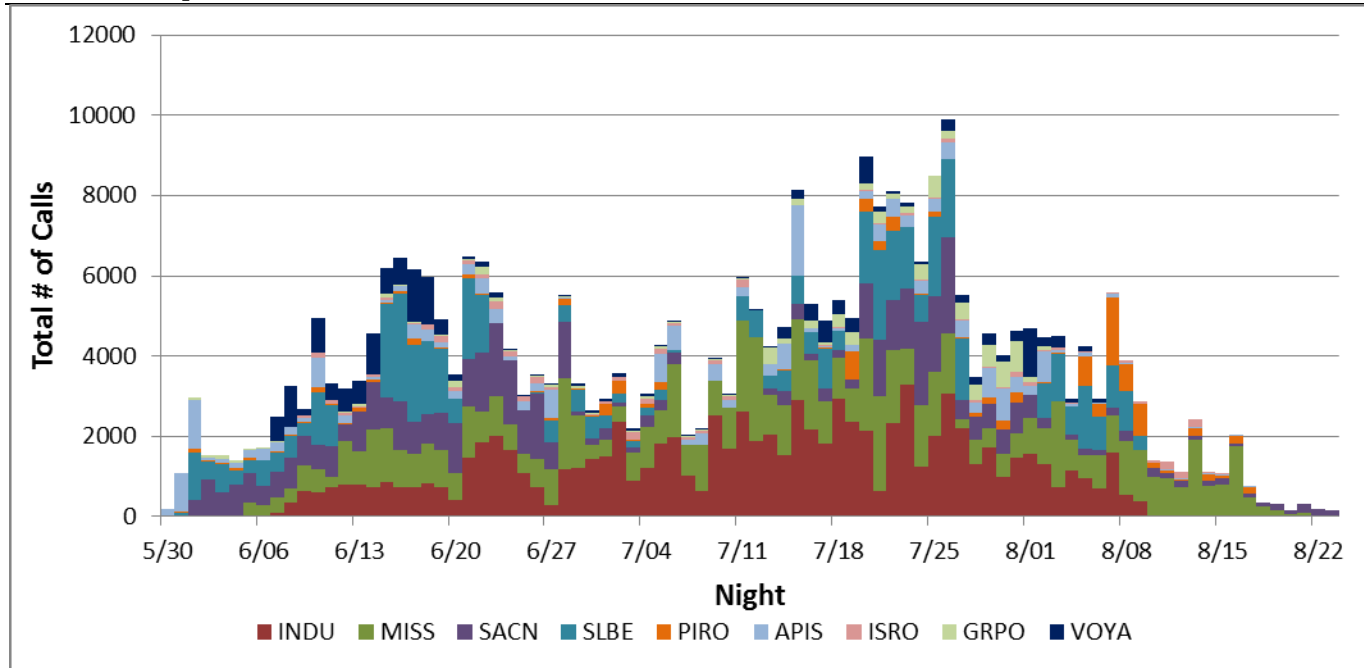


Figure 4-15. Total number of Call Sequences Recorded (All Species Combined), for each Date and Park (Summer only).

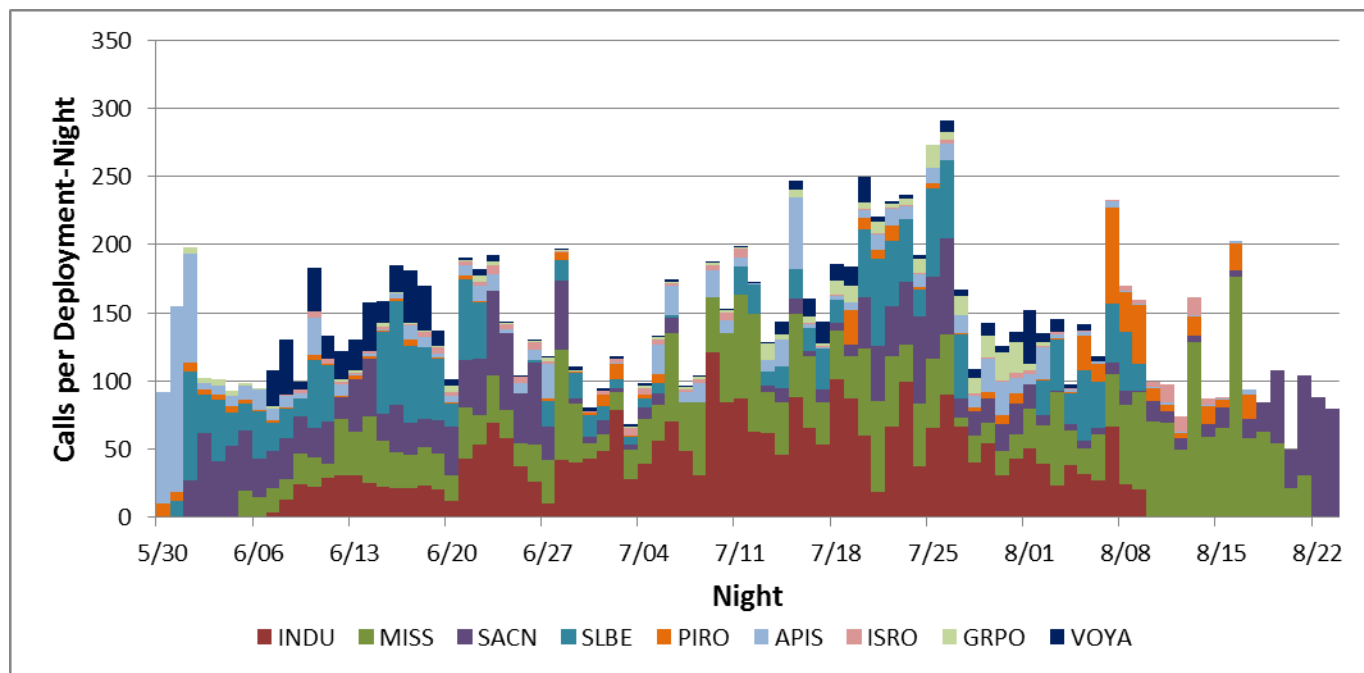


Figure 4-16. Number of Call Sequences Recorded Per Deployment-Night (All Species Combined), for each Date and Park (Summer only).

4.1.4 Percent of Deployments & Deployment-Nights with Calls

Table 4-12 lists the percent of deployments while Table 4-13 lists the percent of deployment-nights where each species was present, for the baseline species analysis. This is for the summer season only. Figure 4-17 plots the data in Table 4-13.

Similarly, Table 4-14 lists the percent of deployments while Table 4-15 lists the percent of deployment-nights where each species was present, for the expanded species analysis. This is for the summer season only. Figure 4-18 plots the data in Table 4-15.

To better highlight the differences in percentages, the table cells are highlighted using a continuous color scale based on the cell values as follows:



Table 4-12. Percent of Deployments each species was present, by Park (Summer Only), Baseline Analysis

Park	Deploy-ments	EPFU	LABO	LACI	LANO	MYLU	MYSE	MYSO	NYHU	PESU
INDU	30	100	100	100	100	100	43	70	100	100
MISS	27	100	100	100	100	100	89	na	na	100
SACN	28	100	100	100	100	100	86	na	na	79
SLBE	35	100	97	100	100	100	71	na	na	na
PIRO	31	84	58	77	87	58	35	na	na	na
APIS	24	63	67	83	75	79	79	na	na	na
ISRO	26	69	81	88	100	88	88	na	na	na
GRPO	18	89	67	100	100	100	56	na	na	na
VOYA	18	78	83	100	100	100	78	na	na	na

na: species was not considered in the analysis

Table 4-13. Percent of Deployment-Nights each species was present, by Park (Summer Only), Baseline Analysis

Park	Deployment-Nights	EPFU	LABO	LACI	LANO	MYLU	MYSE	MYSO	NYHU	PESU
INDU	326	99	100	97	99	84	6	16	92	57
MISS	266	98	97	86	95	97	71	na	na	85
SACN	224	92	84	96	99	94	28	na	na	38
SLBE	300	84	89	79	95	87	29	na	na	na
PIRO	228	34	30	41	57	30	14	na	na	na
APIS	221	29	53	43	51	73	40	na	na	na
ISRO	213	26	46	40	56	72	38	na	na	na
GRPO	169	46	33	62	84	67	30	na	na	na
VOYA	193	35	49	66	83	83	36	na	na	na

na: species was not considered in the analysis

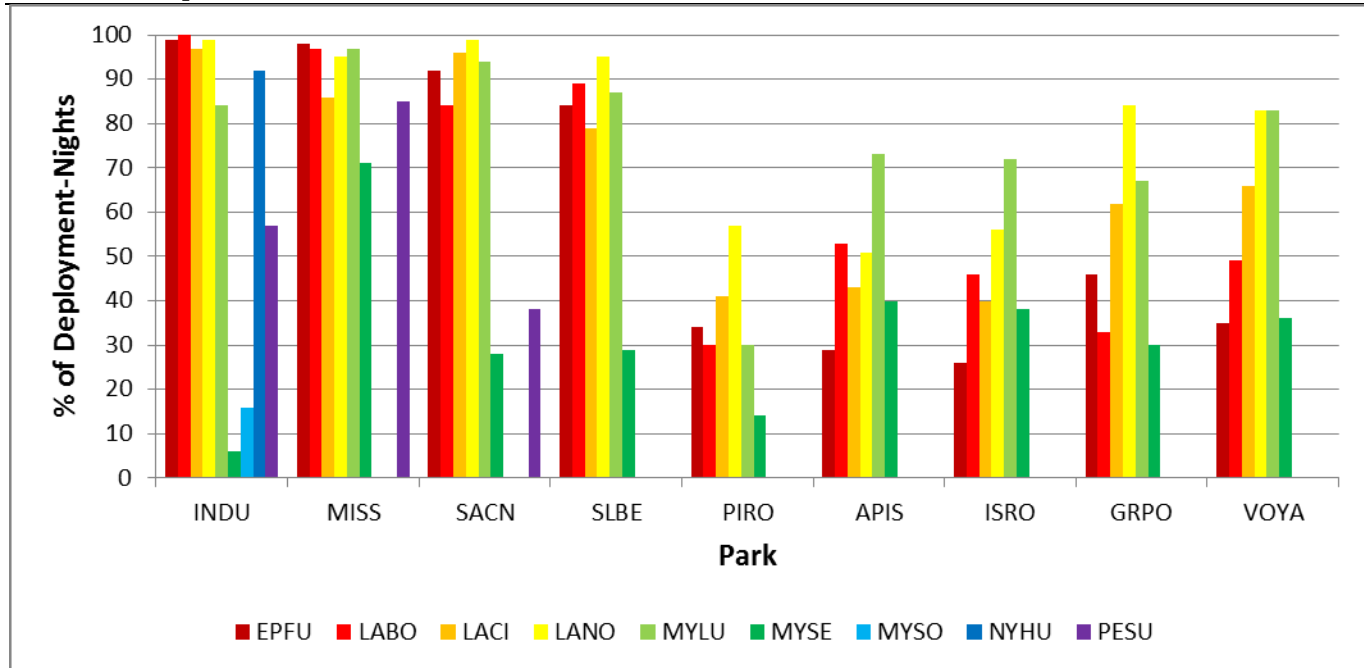


Figure 4-17. Percent of Deployment-Nights each species was present, by Park (Summer only), Baseline Analysis

Table 4-14. Percent of Deployments each species was present, by Park (Summer Only), Expanded Analysis

Park	Deploy-ments	EPFU	LABO	LACI	LANO	MYLU	MYSE	MYSO	NYHU	PESU
INDU	30	100	100	100	100	100	43	70	100	100
MISS	27	100	100	100	100	100	89	na	93	100
SACN	28	100	100	100	100	100	82	na	93	82
SLBE	35	100	97	100	100	100	69	86	na	83
PIRO	31	84	58	77	87	58	35	na	na	19
APIS	24	63	67	83	75	79	79	na	na	46
ISRO	26	69	81	88	100	88	85	na	na	27
GRPO	18	89	67	100	100	100	61	na	na	11
VOYA	18	78	83	100	100	100	78	na	na	44

na: species was not considered in the analysis

Table 4-15. Percent of Deployment-Nights each species was present, by Park (Summer Only), Expanded Analysis

Park	-Nights	EPFU	LABO	LACI	LANO	MYLU	MYSE	MYSO	NYHU	PESU
INDU	326	99	100	97	99	84	6	16	92	57
MISS	266	97	97	86	95	97	70	na	47	85
SACN	224	92	83	96	99	92	27	na	42	37
SLBE	300	84	89	79	95	87	25	40	na	34
PIRO	228	34	30	41	57	31	14	na	na	5
APIS	221	29	52	43	51	73	40	na	na	18
ISRO	213	26	43	40	56	71	38	na	na	4
GRPO	169	46	33	62	84	67	30	na	na	4
VOYA	193	35	48	66	83	83	35	na	na	6

na: species was not considered in the analysis

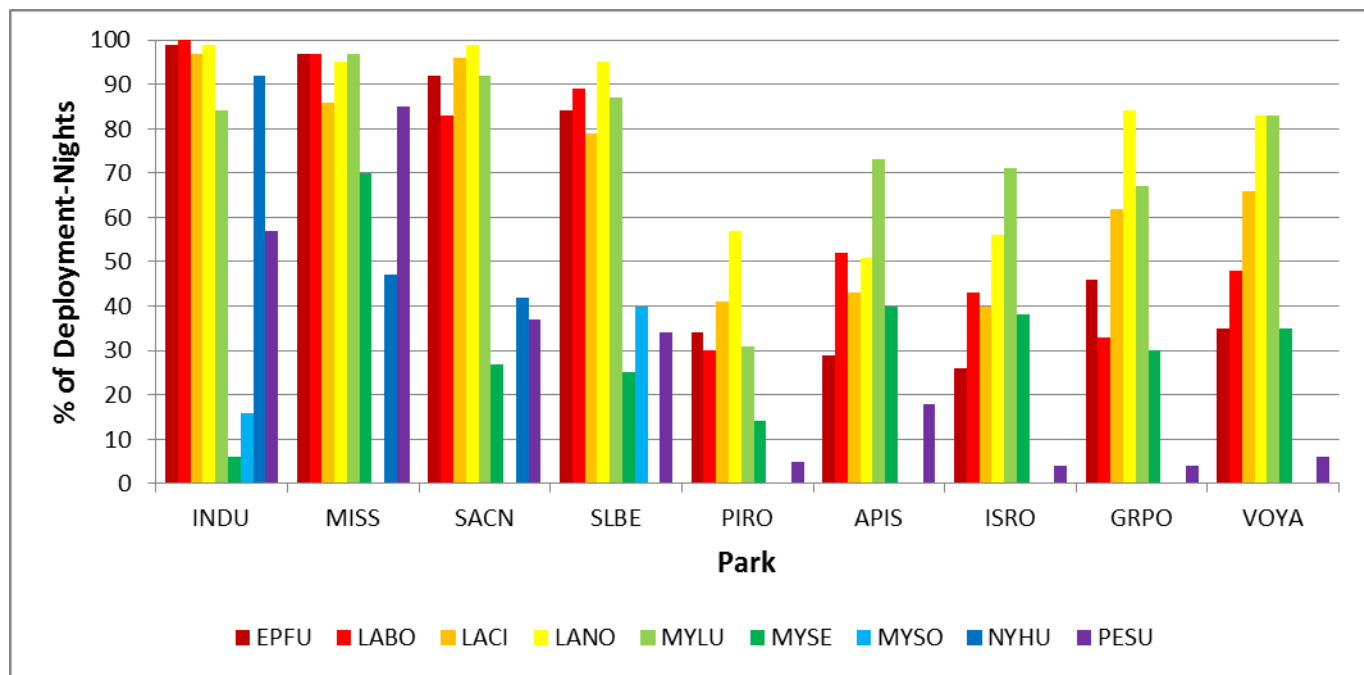


Figure 4-18. Percent of Deployment-Nights each species was present, by Park (Summer only), Baseline Analysis

5 Manual Vetting Summary

5.1.1 Manual Vetting/QC of KPro results

To manually vet the KPro IDs, at least 1% of identified (to species) files were chosen for manual vetting. To be sure that all parks and all species were proportionally represented in the manual vetting, files were NOT randomly selected at large, but instead 1% of files from within a given park and species group were randomly selected with a minimum of 10 files selected for each park and species group.

For example, if Park A had 5000 LABO and 6000 MYSO files, while Park B had 10000 LABO and 3000 MYSO files, the number of files selected for manual vetting would be 50 LABO files and 60 MYSO files from Park A and 100 LABO files and 30 MYSO files from Park B. In addition, if Park C had 500 LABO file, then 10 LABO files would be selected for manual vetting.

Table 5-1 shows the number of files selected for manual vetting, for each park and species, for the baseline analysis

Table 5-1. Number of files manually vetted for species and park, Baseline analysis

Park	EPFU	LABO	LACI	LANO	MYLU	MYSE	MYSO	NYHU	PESU	All Species
INDU	439	179	70	132	16	10	10	39	10	905
MISS	263	58	66	87	226	28	na	na	37	765
SACN	40	94	77	146	109	10	na	na	10	486
SLBE	102	109	74	141	75	10	na	na	na	511
PIRO	10	11	28	47	10	10	na	na	na	116
APIS	10	40	15	30	105	10	na	na	na	210
ISRO	10	10	10	10	27	10	na	na	na	77
GRPO	10	10	14	38	14	10	na	na	na	96
VOYA	10	10	42	15	101	10	na	na	na	188
All Parks	894	521	396	646	683	108	10	39	57	3354

For the expanded analysis, an additional manual vetting was done on the additional park/species combinations added in the expanded analysis. The numbers of files manually vetted for the additional park/species combinations in the expanded analysis are show in Table 5-2.

Table 5-2. Number of additional files manually vetted for species and park, Expanded Analysis

Park	EPFU	LABO	LACI	LANO	MYLU	MYSE	MYSO	NYHU	PESU
INDU	-	-	-	-	-	-	-	-	-
MISS	-	-	-	-	-	-	na	10	-
SACN	-	-	-	-	-	-	na	31	-
SLBE	-	-	-	-	-	-	10	na	10
PIRO	-	-	-	-	-	-	na	na	10
APIS	-	-	-	-	-	-	na	na	10
ISRO	-	-	-	-	-	-	na	na	10
GRPO	-	-	-	-	-	-	na	na	10
VOYA	-	-	-	-	-	-	na	na	10

The files were renamed to strip any information from the file names and the files were placed into folders that indicated the possible species that were supplied to KPro for that file. This ensured that the manual analysis performed by biologists was a blind test with no information about the sites or files besides resident species.

Manual analysis was then performed using several call viewing programs: SonoBat Viewer, Binary Acoustic Technologies SCANR, and Callviewer. Baseline call identification trees and prior knowledge or call shape, durations, and lengths were used to identify bats.

The auto classifier program, KPro, only identifies bats to singular species. Biologists were allowed to ID call sequences as species groups, such as EPFU/LANO or LABO/NYHU.

For the 2017 data, a single biologist performed all manual identifications. This was the same biologist who performed all manual identifications for the 2016 data.

5.1.2 Definition of 'Agreement'

The KPro species identifications were restricted to a single species with the possible species for a given park as listed in Table 4-1. Species groups and unknown species were not allowed in the KPro identifications. The manual species identifications were restricted to the same species as the KPro identifications; however in addition, the manual id allowed call sequences to be identified as species groups, unknown, unknown high frequency, unknown low frequency, unknown Myotis or no bat.

Table 5-3 shows the different manual identifications that were returned by the bat biologist in this study and the KPro identifications that would be considered to be in agreement.

Table 5-3. Manual ID and KPro ID conventions for agreement

Manual ID (species IDs by manual vetter)	KPro ID in ‘agreement’	KPro ID in ‘partial- agreement’
EPFU	EPFU	
EPFU/LANO		EPFU or LANO
LABO	LABO	
LABO/MYLU		LABO or MYLU
LABO/NYHU		LABO or NYHU
LABO/PESU		LABO or PESU
LACI	LACI	
LANO	LANO	
MYLU	MYLU	MYSE or MYSO
MYLU/MYSO		MYLU, MYSE or MYSO
MYSE	MYSE	MYLU or MYSO
MYsp (unknown Myotis)		MYLU, MYSE or MYSO
NYHU	NYHU	
PESU	PESU	
UNKN_HIFREQ		MYLU, MYSE or MYSO
UNKN_LOWFREQ		
NOBAT (not a bat)		

5.1.3 Agreement: Number of Call Sequences

Table 5-4 shows a matrix comparing the manual and KPro identifications. Cells that are highlighted in green are the agreements and cells that are highlighted in orange are the partial agreements for Myotis species. Cells highlighted in light red are the most common disagreements for a given KPro ID.

Table 5-5 shows the manual vetting results for species added in the expanded analysis.

Potential MYSO are always manually identified as MYLU/MYSO and not just MYSO, because MYSO call characteristics always overlap with those of MYLU.

Table 5-4. Manual Vetting Results – Number of Call Sequences, Baseline Analysis

ManualID ¹	EPFU	LABO	LACI	LANO	MYLU	MYSE	MYSO	NYHU	PESU	All Species
EPFU	437	0	1	32	6	1	0	0	0	477
EPFU/LANO	396	6	44	230	3	0	0	0	0	679
LABO	4	380	4	6	55	12	7	20	18	506
LABO/MYLU	0	6	0	0	4	1	0	0	1	12
LABO/NYHU	0	20	0	0	0	0	0	5	0	25
LABO/PESU	0	4	0	0	2	0	0	0	7	13
LACI	14	0	309	25	6	0	0	0	0	354
LANO	14	8	19	328	2	0	0	0	0	371
MYLU	4	34	0	2	573	69	1	0	0	683
MYLU/MYSO²	0	0	0	0	3	0	0	0	0	3
MYSE	1	0	0	0	2	18	0	0	0	21
MYsp	0	0	0	0	7	3	0	0	0	10
NYHU	2	26	0	0	0	0	0	13	0	41
PESU	0	17	0	0	1	0	0	0	29	47
UNKN_HIFREQ	4	18	1	0	18	3	2	1	2	49
UNKN_LOWFREQ	17	2	10	21	1	1	0	0	0	52
NOBAT	1	0	8	2	0	0	0	0	0	11
Total	894	521	396	646	683	108	10	39	57	3354

¹MYsp: unknown Myotis; UNKN: unknown bat call sequence; UNKN_HIFREQ: unknown high frequency bat call sequence; UNKN_LOWFREQ: unknown low frequency bat call sequence; NOBAT: not a bat

² For manual ID all potential MYSO are ID'd as MYLU/MYSO.

■: cells in light green are exact matches

■: cells in light orange are partial matches

■: cells in light red are most common disagreement

Table 5-5. Manual Vetting Results – Number of Call Sequences, Expanded Analysis Species

ManualID ¹	MYSO	NYHU	PESU
LABO	0	13	26
LABO/MYLU	0	0	1
LABO/NYHU	0	10	0
MYLU	1	0	11
MYLU/MYSO²	9	0	1
MYsp	0	0	1
NYHU	0	16	0
PESU	0	0	12
UNKN_HIFREQ	0	1	8
NOBAT	0	1	0
Total	10	41	60

¹MYsp: unknown Myotis; UNKN: unknown bat call sequence; UNKN_HIFREQ: unknown high frequency bat call sequence; UNKN_LOFREQ: unknown low frequency bat call sequence; NOBAT: not a bat

² For manual ID all potential MYSO are ID'd as MYLU/MYSO.

: cells in light green are exact matches

: cells in light orange are partial matches

: cells in light red are most common disagreement

5.1.4 Agreement: Percent

For the baseline analysis, Table 5-6 and Table 5-7 show the agreement between the manual and KPro identifications for non-Myotis species and Myotis species, respectively.

For the additional species considered in the expanded analysis, Table 5-8 and Table 5-9 show the agreement between the manual and KPro identifications for non-Myotis species and Myotis species, respectively.

Table 5-6. Manual Vetting of KPro ID: Percent Agreement for non-Myotis, Baseline Analysis

KPro ID	Total Vetted	# Agree ¹	% Agree	Most Common Disagreements
EPFU	894	833	93.2	UNKN_LOWFREQ, LACI, LANO
LABO	521	410	78.7	MYLU, NYHU
LACI	396	309	78.0	EPFU/LANO, LANO
LANO	646	558	86.4	EPFU, LACI
NYHU	39	18	46.2	LABO
PESU	57	36	63.2	LABO

¹Includes both exact and partial agreements

Table 5-7. Manual Vetting of KPro ID: Percent Agreement for Myotis, Baseline Analysis

KPro ID	# of Files				% of Files			Most Common Disagreements
	Total Vetted	Exact Species	Other Myotis or High Freq.	All Myotis or High Freq.	Exact Species	Other Myotis or High Freq.	All Myotis or High Freq.	
MYLU	683	573	34	607	84	5	89	LABO
MYSE	108	18	76	94	17	70	87	LABO
MYSO	10	0	3	3	0	30	30	LABO

Table 5-8. Manual Vetting of KPro ID: Percent Agreement for non-Myotis, Expanded Analysis

KPro ID	Total Vetted	# Agree ¹	% Agree	Most Common Disagreements
NYHU	41	26	63.4	LABO
PESU	60	12	20.0	LABO

¹Includes both exact and partial agreements

Table 5-9. Manual Vetting of KPro ID: Percent Agreement for Myotis, Expanded Analysis

KPro ID	# of Files				% of Files			Most Common Disagreements
	Total Vetted	Exact Species	Other Myotis or High Freq.	All Myotis or High Freq.	Exact Species	Other Myotis or High Freq.	All Myotis or High Freq.	
MYSO	10	0	10	10	0	100	100	none

6 Conclusion and Observations

The purpose of this report was simply to summarize the results of 2017 GLKN acoustic monitoring effort and not to make conclusions about the ecological significance of the results.

For the 2017 Summer season (6/1/17-9/15/17), 516517 audio files were analyzed from 9 national parks. These were collected at 263 distinct locations during 2140 deployment-nights. Using the auto-classifier Kaleidoscope-Pro (KPro), audio files were identified to species or classified as noise. Both a baseline analysis and an expanded species analysis were performed using the auto-classifier.

For the baseline analysis, overall ~70.9% of the audio files were identified to species, while ~28% were found to be noise. Less than 1% were found to be bat call sequences that could not be identified to species. The PIRO park had an unusually high number of noise files with 87% being classified as noise and only 11% of files identified to species. Excluding PIRO, the remaining parks had 79-91% of audio files identified to species with 8-20% classified as noise. It is not known why the PIRO park had such a high number of noise files, however the equipment and recording settings used there are different than at the remaining parks and this may be a contributing factor. In particular, a high-pass filter was not used at PIRO which may have permitted low frequency noises to be recorded. The expanded species analysis did not reclassify any noise files to species or vice versa; however, the expanded analysis did reclassify a small number files (~0.1%) from a specific species to an unidentifiable bat. It is not known why there was a slight increase in unidentifiable files with the expanded species analysis.

The expanded species analysis reclassified a large number of LABO to NYHU at SACN. LABO and NYHU are two species that overlap very closely and therefore are very difficult to distinguish. The subtle and complex characteristics that biologists use to distinguish LABO and NYHU are probably not modelled in the KPro classifier. When given the possible presence of both NYHU and LABO, KPro may simply be guessing between the two species and therefore a large percentage of calls previously identified as LABO (when NYHU was not a possibility) will be identified as NYHU. LABO call characteristics vary a great deal and overlap with call characteristics for a great many species, thus misclassification of a species as LABO or vice versa tends to be the most common misclassification by KPro.

For call sequences identified by KPro as a *Myotis* species, in the baseline analysis 93% were identified as MYLU while ~7% were identified as MYSE and ~0.09% were identified as MYSO (which was only considered for the INDU park). For the expanded analysis, which allowed MYSO to be considered for both the SLBE and INDU parks, a number of call sequences were reclassified as MYSO in the SLBE park. For the expanded analysis 92% were identified as MYLU while ~7% were identified as MYSE and ~1% were identified as MYSO.

The baseline analysis KPro identification was QC'd by manually vetting about 1% of the files identified to species. Additionally, species/park combinations added to the expanded analysis were separately QC'd by manually vetting 1% of the files identified to the expanded species.

In the baseline analysis, for call sequences identified by KPro as non-myotis species, the KPro and manual identifications had good agreement for some species and less for others. For EPFU, the agreement was reasonably high at 93% and but for NYHU the agreement was relatively low at only 49%. Other species ranged in agreement from 63%-79%. The low agreement percentage for NYHU is due in large part to the difficulty of distinguishing NYHU from LABO, as mentioned previously. PESU calls are fairly distinctive but are often misclassified by KPro as LABO. For the expanded analysis, for call sequences identified by KPro as non-myotis species, manual identification did not agree well with the KPro identification. For the files identified by KPro as NYHU, the manual ID agreed only 63% and for PESU only 20%, with a manual identification of LABO being the most common disagreement.

In the baseline analysis, for call sequences identified by KPro as Myotis species, the agreement between KPro and manual identification was mixed. For files identified by KPro as MYLU, the agreement was very good; with 84% also manually identified as MYLU and 89% manually identified as a Myotis species call sequence. For files identified by KPro as MYSE, only 17% were also manually identified as MYSE but 87% were manually identified as a Myotis species. For files identified by KPro as MYSO, the agreement was not good, with only 30% manually identified as Myotis and with 70% being manually identified as LABO. However, there were so few MYSO files that results are difficult to interpret.

For the expanded analysis which added MYSO for SLBE, manual identification agreed with KPro identification. For the files identified by KPro as MYSO, the manual identification was MYLU/MYSO for 9 of 10 files and MYLU for 1 of 10 files.

The auto classifier programs approved by the USFWS for MYSO and MYSE projects (including KPro), are tuned to be extra sensitive towards endangered species such as MYSO and MYSE. This can explain the number of audio files manually identified as LABO but identified by KPro as MYSE and MYSO.

The manual vetting did agree that the files identified by KPro as MYLU or MYSE were some type of Myotis about 88% of the time, thus an identification by KPro of MYLU or MYSE could at least be a flag for a potential Myotis.

Based on the data tables presented in this report, there was nothing highly unusual about distribution of species (as determined by KPro identification) among the parks or the relative nightly activity throughout the season. A thorough analysis is, of course, needed to quantify this observation, correct for discrepancies between KPro and manual identification and compare these results with bat species prevalence reported in the general literature. This is an ongoing study with four years of data collection so far completed (2015-2018) and a fifth year planned for 2019. Data analysis using the methods presented in this report has only been done for 2016-2017 data but 2015 and 2018 will be completed in the near future.

7 Supplementary Documents

The following documents contain detailed information and data that are important to the 2017 reporting of results, but are too big to be included in this report and are better provided as supplementary documents:

- [*Data Management Plan.docx*](#)
 - Detailed information about the procedures for data management and processing as well as step-by-step instruction for automatic identification using KPro.
- [*tables_2017_SpeciesCalls_byParkSiteNight_AutoID.xlsx*](#)
 - Number of call sequences for each species (as ID'd by KPro for both baseline and expanded species lists) for each site and night combination
 - Total number of call sequences for each species (as ID'd by KPro for both baseline and expanded species lists) for each site with all nights combined
 - Number of call sequences per deployment-night for each site, for each species (as ID'd by KPro for both baseline and expanded species lists)
- [*tables_2017_AudioFile_Classification_byParkSite.xlsx*](#) Audio file classification (bad files, short deployment fields, etc.) for each Park and site.
- [*tables_2017_CallsvsNoise_byParkSite.xlsx*](#) Number and percent files ID'd as bats and noise files for each Park and site.

8 APPENDIX

Table 8-1. Number of Deployments By Date, during the Summer season (Figure 3-2)

Night	All Parks	INDU	MISS	SACN	SLBE	PIRO	APIS	ISRO	GRPO	VOYA
5/30/2017	2	0	0	0	0	1	1	0	0	0
5/31/2017	7	0	0	0	4	1	2	0	0	0
6/1/2017	15	0	0	3	6	1	2	0	3	0
6/2/2017	15	0	0	3	6	1	2	0	3	0
6/3/2017	15	0	0	3	6	1	2	0	3	0
6/4/2017	15	0	0	3	6	1	2	0	3	0
6/5/2017	17	0	2	3	6	1	2	0	3	0
6/6/2017	18	0	2	3	6	1	3	0	3	0
6/7/2017	23	2	2	3	6	3	3	0	3	1
6/8/2017	25	3	2	2	6	4	3	2	0	3
6/9/2017	27	4	2	2	6	4	2	4	0	3
6/10/2017	27	4	2	2	6	4	2	4	0	3
6/11/2017	25	4	2	2	5	4	1	4	0	3
6/12/2017	26	4	3	2	0	4	1	4	3	5
6/13/2017	26	4	3	2	0	4	1	4	3	5
6/14/2017	29	5	4	2	0	4	2	4	3	5
6/15/2017	39	6	4	3	6	5	3	4	3	5
6/16/2017	35	5	4	3	6	6	3	0	3	5
6/17/2017	34	5	4	3	6	6	3	1	3	3
6/18/2017	35	5	4	3	6	6	3	3	3	2
6/19/2017	36	6	4	3	6	6	3	3	3	2
6/20/2017	35	6	4	3	6	5	3	3	3	2
6/21/2017	34	6	4	3	6	4	4	3	3	1
6/22/2017	35	6	4	3	6	3	4	3	3	3
6/23/2017	29	6	4	3	0	3	4	3	3	3
6/24/2017	29	6	4	3	0	3	4	3	3	3
6/25/2017	29	6	4	3	0	3	4	3	3	3
6/26/2017	27	6	3	3	3	2	3	2	3	2
6/27/2017	28	4	3	3	5	2	3	2	3	3
6/28/2017	28	4	3	3	5	2	3	2	3	3
6/29/2017	30	5	3	2	6	2	3	1	3	5
6/30/2017	33	6	3	2	6	2	3	3	3	5
7/1/2017	31	6	3	2	6	2	3	4	0	5
7/2/2017	30	6	3	2	6	2	2	4	0	5
7/3/2017	32	5	4	2	6	2	2	4	3	4
7/4/2017	31	5	4	2	6	2	2	4	3	3
7/5/2017	32	5	4	2	6	2	3	4	3	3
7/6/2017	28	6	4	2	2	1	3	4	3	3
7/7/2017	21	5	4	0	0	1	3	3	3	2
7/8/2017	21	5	4	0	0	1	3	3	3	2
7/9/2017	21	5	4	0	0	1	3	3	3	2
7/10/2017	20	5	4	0	0	1	3	3	3	1

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Night	All Parks	INDU	MISS	SACN	SLBE	PIRO	APIS	ISRO	GRPO	VOYA
7/11/2017	30	6	4	0	5	1	4	4	3	3
7/12/2017	30	6	4	0	5	1	4	4	3	3
7/13/2017	33	6	4	3	5	1	4	4	3	3
7/14/2017	33	6	4	3	5	1	4	2	3	5
7/15/2017	33	6	4	3	5	1	4	2	3	5
7/16/2017	33	6	4	3	5	1	3	3	3	5
7/17/2017	34	6	4	3	5	1	3	4	3	5
7/18/2017	29	6	4	3	2	1	2	3	3	5
7/19/2017	27	6	4	3	0	1	2	3	3	5
7/20/2017	36	5	4	5	6	2	2	4	3	5
7/21/2017	35	5	4	5	6	2	4	4	3	2
7/22/2017	35	5	4	5	6	2	4	4	3	2
7/23/2017	33	5	4	5	6	2	4	4	1	2
7/24/2017	33	4	4	5	6	2	4	4	3	1
7/25/2017	31	5	4	5	6	2	3	3	3	0
7/26/2017	34	5	4	5	6	3	3	2	3	3
7/27/2017	33	5	3	5	6	3	3	2	3	3
7/28/2017	32	5	4	5	0	4	4	4	3	3
7/29/2017	32	5	4	5	0	4	4	4	3	3
7/30/2017	32	5	4	5	0	4	4	4	3	3
7/31/2017	34	7	4	5	0	4	4	4	3	3
8/1/2017	31	5	4	4	0	4	4	4	3	3
8/2/2017	33	5	4	4	3	3	4	4	3	3
8/3/2017	31	5	3	2	6	5	3	4	0	3
8/4/2017	30	5	3	2	6	5	2	4	0	3
8/5/2017	30	5	3	2	6	5	2	4	0	3
8/6/2017	25	5	3	2	6	5	1	2	0	1
8/7/2017	24	5	3	2	6	5	2	1	0	0
8/8/2017	23	3	3	2	6	5	2	2	0	0
8/9/2017	18	2	4	2	2	4	2	2	0	0
8/10/2017	14	0	4	2	0	4	2	2	0	0
8/11/2017	14	0	4	2	0	4	2	2	0	0
8/12/2017	15	0	4	2	0	4	2	3	0	0
8/13/2017	15	0	4	2	0	4	2	3	0	0
8/14/2017	13	0	3	2	0	4	2	2	0	0
8/15/2017	12	0	3	2	0	4	2	1	0	0
8/16/2017	10	0	3	2	0	3	2	0	0	0
8/17/2017	8	0	2	2	0	3	1	0	0	0
8/18/2017	4	0	2	2	0	0	0	0	0	0
8/19/2017	3	0	1	2	0	0	0	0	0	0
8/20/2017	3	0	1	2	0	0	0	0	0	0
8/21/2017	3	0	1	2	0	0	0	0	0	0
8/22/2017	2	0	0	2	0	0	0	0	0	0
8/23/2017	2	0	0	2	0	0	0	0	0	0

Table 8-2. Number of Calls Per Deployment-Night (All Parks Combined), for each Species, Baseline Analysis (Figure 4-10)

Night	EPFU	LABO	LACI	LANO	MYLU	MYSE	MYSO	NYHU	PESU
5/30/2017	0	5	0	1.5	84.5	0.5	0	0	0
5/31/2017	1.4	3.1	2.1	7.7	139.7	0.6	0	0	0
6/1/2017	20.5	5.3	13.3	66.7	87.1	2.3	0	0	0.3
6/2/2017	17.8	4.7	24.6	33.8	18.5	0.9	0	0	1
6/3/2017	11.3	4.5	28.7	28.3	23.2	2.7	0	0	1.1
6/4/2017	9.9	3.8	8.3	33.2	33.7	2	0	0	0.4
6/5/2017	11.8	6.4	7.5	25.9	41.6	1.8	0	0	2
6/6/2017	11.8	5.2	9.9	37.4	26.1	1.9	0	0	1.6
6/7/2017	13.7	6	50.2	22	11.7	1.8	0	0.3	1
6/8/2017	9.8	6.4	56.3	31	22.8	0.6	0	0.3	2.2
6/9/2017	21.4	6.9	20.8	30.5	13.1	0.7	0	0.9	3.7
6/10/2017	30	6.8	56.1	74.2	10	0.7	0	1.1	2.1
6/11/2017	11.5	11.9	35.5	40.5	21.7	1.1	0.1	1.5	7.2
6/12/2017	28.8	13.9	11.9	22.4	37.1	2.8	0	1.7	1.8
6/13/2017	25.8	12.6	11.9	28.4	40	2.3	0.1	2.4	4.2
6/14/2017	35.6	8.3	16.3	30.8	59.3	2.7	0	0.7	1.8
6/15/2017	31.8	12.7	21.7	51	36.7	1.3	0.1	1.3	0.4
6/16/2017	37.1	13.5	21.7	62.7	44.5	1.9	0	0.9	0.5
6/17/2017	29.2	11.4	25	48.6	61.1	2.4	0.1	1	0.3
6/18/2017	28.8	11.4	17.4	44.2	60.5	4.8	0.1	1	0.6
6/19/2017	18.6	12.4	12	35	50.5	4.8	0	0.9	0.6
6/20/2017	10.9	8.9	14.1	18.2	43.9	2	0	1.1	0.5
6/21/2017	58.1	17.9	17	39.5	50.8	3.4	0	1.4	0.9
6/22/2017	51.3	16.5	26.7	51.9	29.3	1.7	0	1.1	0.4
6/23/2017	67.2	10.7	38.4	31.5	35.1	3.9	0.2	0.9	1.5
6/24/2017	49.1	12.6	32	22.4	19.2	3.9	0.1	1.2	1.1
6/25/2017	28.1	11.9	18.4	20.4	16.6	4.7	0.1	1.7	0.8
6/26/2017	20.8	18.4	34.3	23	27.2	2	0.1	2.9	0.3
6/27/2017	30.7	7.4	12.8	27.3	36	2.4	0	0.5	0.2
6/28/2017	85.1	7.8	19.1	31.9	48.2	1.3	0	0.2	0.4
6/29/2017	71.7	3.3	4.2	22.5	5.9	1.2	0	0.2	0.3
6/30/2017	17.2	10.4	10.1	29	6.9	2.7	0	0.9	1.5
7/1/2017	24.3	10.4	13.2	30.6	8	5.6	0.1	1	0.4
7/2/2017	40.7	8.7	6.2	46.5	9.5	4.1	0	0.6	0.8
7/3/2017	19.5	7.1	8.5	12.6	12.7	4.8	0	0.5	2.1
7/4/2017	30.3	12.1	12.1	24.8	11	2.3	0	1	3.7
7/5/2017	34.3	26.9	16.1	29.9	15.4	4.4	0	2.3	2.9
7/6/2017	40.4	36	14.1	31.5	32.6	11.2	0	2.1	4.5
7/7/2017	30.9	21.7	9.9	11.2	9.4	5.4	0	2.3	4.5
7/8/2017	11.8	26.3	15.4	7.4	25.9	10.7	0	2.3	3
7/9/2017	65.2	38.6	32.7	22.6	12.2	4.4	0.1	5.8	3.4

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Night	EPFU	LABO	LACI	LANO	MYLU	MYSE	MYSO	NYHU	PESU
7/10/2017	40.8	33	20	23.2	18.8	6.7	0	4.6	3.6
7/11/2017	54.4	34.1	17.2	16.8	55.7	8.8	0	4.1	6.8
7/12/2017	80.3	17.8	14.8	11.5	40.5	1	0.1	2.1	2.5
7/13/2017	35.3	30.2	11.7	10.8	32.4	1.2	0	3.7	1.7
7/14/2017	26.7	33.6	13.5	22.1	36.8	1.9	0	2.3	4.4
7/15/2017	67.2	58.8	10.7	22.6	72.8	1.6	0	5.1	6.2
7/16/2017	47.4	26.5	11.5	21.7	40.5	2.2	0.1	2.7	5.6
7/17/2017	39.1	23.4	20.4	24.1	28.7	1	0.1	2.4	2.6
7/18/2017	74.8	34.3	18.6	18.8	27.2	1.3	0	4.8	3.5
7/19/2017	45.3	30.2	20.8	49.3	26.4	1.5	0.1	5.3	2
7/20/2017	79.2	52.8	28.6	38	37.9	2.1	0	3.7	3.9
7/21/2017	68.1	54	23.3	34.4	31	0.7	0	1.5	4.9
7/22/2017	73.5	58.6	25.7	34.7	29.3	0.8	0	2.7	3.1
7/23/2017	93.4	55.2	13.4	34.2	32.7	1.7	0.1	2.6	1.2
7/24/2017	54.1	62.9	13.1	33.3	23.5	1.7	0	0.9	1.9
7/25/2017	90.7	55.6	48.8	44.8	24.9	0.9	0	2.1	3.4
7/26/2017	96.7	77.4	41.6	38.2	23.1	1.1	0	3.8	6
7/27/2017	63.5	24.9	15.2	32	25.2	1.5	0.1	2.5	0.7
7/28/2017	33	15.1	8.9	26.4	19.8	0.8	0	2.8	1.1
7/29/2017	46.6	16.6	17.9	34.8	19.9	1.1	0	2.2	1.7
7/30/2017	35	13.5	11.2	42.2	18.8	1.5	0.1	1.1	0.7
7/31/2017	38.5	19.5	15.9	39.8	16.9	1.1	0	2.4	0.5
8/1/2017	48.9	14.6	3.6	27.7	50.1	1.3	0	3.2	1.2
8/2/2017	32	31.8	5.3	18.6	38.1	3.2	0	3.3	2.1
8/3/2017	15.3	33.6	3.9	9.3	74	2.5	0	2.1	2.6
8/4/2017	12.7	29.2	1.3	25.9	20.9	1.2	0	3.4	1.6
8/5/2017	22.7	57.1	18.9	13.9	20	1.2	0	2.4	1.8
8/6/2017	26	34.9	8.3	10.9	29.8	1.4	0	1.6	1.8
8/7/2017	52.8	65.6	54.4	22.2	25.9	2	0	5.2	1.4
8/8/2017	46.5	47.3	20.6	19.2	29.4	1.5	0	0.7	1.9
8/9/2017	12.4	47.3	14.7	28.8	41.2	2.3	0	1.1	9.2
8/10/2017	20.9	6.1	3.7	22.1	37.5	1.5	0	0	5.1
8/11/2017	34.4	4.3	9.4	15.9	27.9	1.7	0	0	2.6
8/12/2017	21	3.7	5.3	11.1	28.7	1.7	0	0	2.5
8/13/2017	29.4	18.3	12.3	23.1	67.4	2.3	0	0	7.4
8/14/2017	26.1	3.8	5.8	24.8	22.6	0.9	0	0	1.6
8/15/2017	31.2	4.6	3.8	21.2	19.5	0.6	0	0	1.8
8/16/2017	31.7	24.3	4.1	29.2	76.7	1.1	0	0	32.9
8/17/2017	31.8	2.6	5	33.9	15.8	1.2	0	0	0.9
8/18/2017	25.8	6.2	3.2	20.2	23.8	1.2	0	0	3
8/19/2017	9.7	10.3	9.7	60.3	12	0.7	0	0	2
8/20/2017	3.3	5	6	21.7	8.7	0	0	0	1.7
8/21/2017	3	6.7	18	60.7	9	0	0	0	4

Night	EPFU	LABO	LACI	LANO	MYLU	MYSE	MYSO	NYHU	PESU
8/22/2017	9.5	6	9.5	46	15.5	0	0	0	0.5
8/23/2017	16.5	5	19	23.5	13	0	0	0	0.5

Table 8-3. Number of Calls Per Deployment-Night (All Parks Combined), for each Species, Expanded Analysis (Figure 4-12)

Night	EPFU	LABO	LACI	LANO	MYLU	MYSE	MYSO	NYHU	PESU
5/30/2017	0	5	0	1.5	84.5	0.5	0	0	0
5/31/2017	1.4	3.3	2.1	7.7	139.4	0.6	0.1	0	0
6/1/2017	20.5	4.9	13.3	66.7	87.1	2.3	0.4	0	0.3
6/2/2017	17.8	4.7	24.6	33.8	18.6	0.9	0	0	1
6/3/2017	11.3	4.5	28.7	28.3	23.2	2.7	0	0	1.1
6/4/2017	9.9	3.7	8.3	33.2	33.7	2	0.1	0	0.4
6/5/2017	11.7	6.2	7.5	25.9	41.4	1.9	0	0.3	2.1
6/6/2017	11.8	5	9.9	37.4	26.2	1.9	0.1	0.1	1.6
6/7/2017	13.7	5.8	50.2	22	11.6	1.8	0	0.5	1
6/8/2017	9.9	6.2	56.2	31.1	22.8	0.6	0.1	0.4	2.2
6/9/2017	21.4	6.6	20.8	30.5	13.2	0.7	0	1	3.7
6/10/2017	30	6.7	56.1	74.2	10	0.7	0	1.1	2.1
6/11/2017	11.4	11.8	35.5	40.5	21.6	1.1	0.2	1.5	7.3
6/12/2017	28.8	13.7	12	22.4	37	2.8	0	1.8	1.8
6/13/2017	25.8	12.3	12	28.4	40.2	2.3	0.1	2.4	4.2
6/14/2017	35.6	8	16.3	30.7	59.4	2.7	0	0.8	1.8
6/15/2017	31.8	12.2	21.7	51.1	35.7	1.2	1	1.3	0.6
6/16/2017	37.2	13	21.7	62.7	42.9	1.8	1.4	1	0.8
6/17/2017	29.1	11.1	25	48.8	59.8	2.1	1.4	1.1	0.4
6/18/2017	28.8	11.4	17.4	44.2	59.3	4.8	0.8	1.1	0.7
6/19/2017	18.6	12.3	12	35	48.8	4.8	1.2	1	0.9
6/20/2017	10.9	8.9	14.1	18.2	43.4	1.9	0.4	1.1	0.6
6/21/2017	58.1	17.3	17	39.6	48.2	3.3	2.5	1.5	1.2
6/22/2017	51.3	16.1	26.7	51.9	27.3	1.5	2	1.2	0.6
6/23/2017	67.2	10.7	38.4	31.5	35.2	3.8	0.2	0.9	1.5
6/24/2017	49.1	12.4	32	22.4	19.2	3.9	0.1	1.3	1.1
6/25/2017	28.1	11.9	18.4	20.4	16.6	4.7	0.1	1.8	0.8
6/26/2017	20.8	18.5	34.3	23	27	2	0.1	2.9	0.3
6/27/2017	30.7	7.3	12.8	27.3	35.8	2.4	0.2	0.7	0.2
6/28/2017	85.1	7.4	19.1	31.9	48.2	1.2	0.1	0.6	0.4
6/29/2017	71.7	3	4.2	22.5	5.9	1.2	0.1	0.2	0.4
6/30/2017	17.2	10.2	10.1	29.1	6.8	2.8	0.2	1	1.5
7/1/2017	24.2	10.3	13.2	30.6	8	5.6	0.1	1	0.4
7/2/2017	40.7	8.4	6.2	46.5	9.3	4.1	0.2	0.7	0.9
7/3/2017	19.5	7.1	8.5	12.6	12.4	4.7	0.2	0.6	2.1
7/4/2017	30.3	11.9	12.1	24.8	10.9	2.3	0.1	1.2	3.7
7/5/2017	34.3	26.8	16.1	29.9	15.3	4.4	0.2	2.4	2.9
7/6/2017	40.5	35.9	14.1	31.5	32.6	11.2	0	2.2	4.5

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Night	EPFU	LABO	LACI	LANO	MYLU	MYSE	MYSO	NYHU	PESU
7/7/2017	30.9	21.5	9.9	11.2	9.4	5.4	0	2.4	4.5
7/8/2017	11.8	26.2	15.4	7.4	25.8	10.7	0	2.4	3
7/9/2017	65.2	38.7	32.7	22.6	12	4.4	0.1	5.9	3.4
7/10/2017	40.8	33	20	23.2	18.6	6.6	0	4.9	3.6
7/11/2017	54.4	33.9	17.2	16.8	55	8.9	0.7	4.1	6.8
7/12/2017	80.3	17	14.8	11.5	40.4	0.9	0.2	2.7	2.7
7/13/2017	35.3	29.6	11.7	10.8	32.1	1.1	0.5	3.8	2
7/14/2017	26.7	32.4	13.5	22.1	36.5	1.8	0.3	2.7	5.2
7/15/2017	67.2	57.6	10.7	22.6	72.4	1.5	0.9	5.7	6.5
7/16/2017	47.4	25	11.5	21.7	40.1	2.2	0.7	3	6.4
7/17/2017	39.2	22.6	20.4	24.1	28.7	1	0.4	2.4	3
7/18/2017	74.9	33.7	18.5	18.7	27.4	1.3	0.1	4.9	3.7
7/19/2017	45.3	29.7	20.8	49.3	26.6	1.5	0.1	5.5	2
7/20/2017	79.3	52.3	28.6	38	37.5	2.1	0.4	4.1	4
7/21/2017	68.2	53	23.3	34.3	30.5	0.7	0.7	1.9	4.9
7/22/2017	73.5	57	25.7	34.7	29.1	0.8	0.3	3.3	3.7
7/23/2017	93.4	54.1	13.4	34.2	31.7	1.8	1.2	3.1	1.4
7/24/2017	54.1	62	13.1	33.4	23.3	1.7	0.2	1.6	2.1
7/25/2017	90.8	54.8	48.9	44.8	24.7	0.8	0.2	2.5	3.6
7/26/2017	96.7	76.5	41.6	38.2	23.1	1.1	0.1	4.4	6.1
7/27/2017	63.5	24.6	15.2	32	24.7	1.4	0.7	2.5	0.8
7/28/2017	33	15	8.9	26.4	19.7	0.8	0	2.9	1.2
7/29/2017	46.6	16.5	17.9	34.7	19.9	1	0	2.3	1.7
7/30/2017	35	13.4	11.2	42.1	18.8	1.5	0.1	1.1	0.7
7/31/2017	38.5	19.4	15.9	39.7	17	1.1	0	2.4	0.6
8/1/2017	48.9	14.3	3.6	27.7	50.2	1.3	0	3.3	1.2
8/2/2017	32	30.7	5.3	18.6	38.2	3.2	0.5	3.5	2.3
8/3/2017	15.3	31.2	3.9	9.3	73.9	2.5	0.7	2.2	3.6
8/4/2017	12.8	27.8	1.3	25.9	20.5	1.1	0.5	3.5	2.6
8/5/2017	22.7	55.5	18.9	13.9	19.7	1.2	0.5	2.5	3
8/6/2017	26	33.4	8.3	10.9	29.7	1.3	0.5	1.8	2.3
8/7/2017	52.8	64.5	54.4	22.2	25.6	1.9	0.9	5.3	1.8
8/8/2017	46.5	44.9	20.7	19.1	29.1	1.5	0.7	0.8	3.2
8/9/2017	12.4	46.3	14.7	28.8	41	2.3	0.6	1.1	9.4
8/10/2017	20.9	5.8	3.7	22.1	37.6	1.5	0	0.1	5.1
8/11/2017	34.4	4.3	9.4	15.9	28.1	1.6	0	0	2.6
8/12/2017	21	3.4	5.3	11	28.7	1.7	0	0.2	2.5
8/13/2017	29.5	18.3	12.4	23	67	2.3	0	0.3	7.3
8/14/2017	26.2	3.7	5.8	24.8	22.5	0.9	0	0.2	1.7
8/15/2017	31.2	4.3	3.8	21.2	19.6	0.6	0	0.1	1.8
8/16/2017	31.7	23.7	4.1	29.2	76.1	1.1	0	0.7	32.8
8/17/2017	31.8	2.4	5	33.9	15.8	1.2	0	0	0.9
8/18/2017	25.8	5.5	3.2	20.2	23.8	1.2	0	0.5	3

Night	EPFU	LABO	LACI	LANO	MYLU	MYSE	MYSO	NYHU	PESU
8/19/2017	9.7	10	9.7	60.3	12	0.7	0	0.3	2
8/20/2017	3.3	4.7	6	21.7	8.7	0	0	0.3	1.7
8/21/2017	3	7	18	60.7	8	0	0	0.3	4.3
8/22/2017	9.5	6	9.5	46	15.5	0	0	0	0.5
8/23/2017	16.5	5	19	23.5	13	0	0	0	0.5

Table 8-4. Total number of Calls Recorded (All Species Combined), for each Date and Park (Summer only) (Figure 4-15)

Night	INDU	MISS	SACN	SLBE	PIRO	APIS	ISRO	GRPO	VOYA
5/30/2017	0	0	0	0	20	163	0	0	0
5/31/2017	0	0	0	86	47	953	0	0	0
6/1/2017	0	0	410	1195	94	1202	0	71	0
6/2/2017	0	0	934	423	57	63	0	52	0
6/3/2017	0	0	619	680	54	91	0	75	0
6/4/2017	0	0	785	372	66	109	0	58	0
6/5/2017	0	342	740	334	54	178	0	30	0
6/6/2017	0	278	495	635	4	276	0	20	0
6/7/2017	84	404	636	465	43	208	0	33	604
6/8/2017	336	361	771	537	26	208	10	0	1018
6/9/2017	653	616	740	336	17	109	58	0	162
6/10/2017	603	593	585	1326	120	724	124	0	871
6/11/2017	738	246	783	1022	21	14	81	0	421
6/12/2017	796	1095	405	0	26	213	48	48	545
6/13/2017	793	829	1010	0	78	17	33	45	584
6/14/2017	729	1429	1207	0	56	66	49	11	1024
6/15/2017	861	1341	764	2329	35	63	72	85	631
6/16/2017	743	916	1224	2674	73	111	0	50	665
6/17/2017	745	826	781	1922	156	351	45	26	1308
6/18/2017	827	978	743	1814	10	277	129	19	1167
6/19/2017	735	939	902	1612	28	118	157	37	391
6/20/2017	429	654	1239	603	21	173	98	170	145
6/21/2017	1480	1277	1174	2020	76	273	77	41	63
6/22/2017	1854	767	1450	1458	35	366	115	168	151
6/23/2017	2003	1000	1793	0	14	355	191	78	143
6/24/2017	1673	614	1619	0	1	88	120	24	34
6/25/2017	1096	475	1075	0	3	217	136	0	21
6/26/2017	720	709	1638	35	11	201	155	33	31
6/27/2017	297	896	668	519	66	703	64	71	31
6/28/2017	1179	2255	1430	413	157	18	8	25	5
6/29/2017	1206	1307	93	564	31	3	1	42	68
6/30/2017	1423	375	162	527	42	8	24	13	79
7/1/2017	1501	398	301	324	280	4	66	0	66
7/2/2017	2354	404	79	216	334	6	89	0	79

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Night	INDU	MISS	SACN	SLBE	PIRO	APIS	ISRO	GRPO	VOYA
7/3/2017	895	688	131	182	33	0	174	21	73
7/4/2017	1224	1014	272	187	103	5	141	56	50
7/5/2017	1812	837	256	241	219	677	125	66	42
7/6/2017	1970	1821	296	55	0	601	72	24	40
7/7/2017	1022	749	0	0	0	159	36	39	28
7/8/2017	648	1128	0	0	0	292	56	38	23
7/9/2017	2532	866	0	0	0	412	72	34	17
7/10/2017	1692	1015	0	0	0	185	121	28	12
7/11/2017	2603	2284	0	615	0	200	202	34	46
7/12/2017	1887	2586	0	651	3	16	5	1	12
7/13/2017	2052	966	170	331	4	288	4	409	28
7/14/2017	1525	1262	347	519	10	645	22	131	293
7/15/2017	2907	2017	372	707	1	1741	21	174	221
7/16/2017	2179	1723	140	548	0	91	21	181	419
7/17/2017	1831	1039	328	999	5	49	30	82	550
7/18/2017	2938	1030	174	489	2	75	16	316	345
7/19/2017	2355	846	220	0	691	155	6	315	372
7/20/2017	2145	2306	1352	1804	297	199	43	158	673
7/21/2017	642	2363	1406	2226	237	399	35	282	130
7/22/2017	2344	1805	1260	1696	373	431	23	116	54
7/23/2017	3283	903	1511	1510	11	294	51	149	94
7/24/2017	1250	1513	2103	651	50	310	38	358	88
7/25/2017	2026	1568	1882	1989	121	344	15	532	0
7/26/2017	3075	1491	2383	1963	6	392	94	206	277
7/27/2017	2197	222	470	1535	37	429	10	446	186
7/28/2017	1297	626	574	0	97	250	72	366	201
7/29/2017	1737	480	584	0	152	757	39	527	286
7/30/2017	982	580	619	0	223	786	34	634	153
7/31/2017	1456	617	755	0	256	405	121	758	257
8/1/2017	1556	902	567	0	13	207	99	134	1230
8/2/2017	1299	913	254	859	12	766	37	105	226
8/3/2017	718	2139	9	1184	23	74	80	0	275
8/4/2017	1144	765	138	683	22	63	20	0	105
8/5/2017	956	571	166	1549	744	107	21	0	131
8/6/2017	687	832	126	833	339	35	4	0	93
8/7/2017	1609	920	188	1041	1705	93	2	0	0
8/8/2017	555	1337	245	1003	663	19	86	0	0
8/9/2017	371	1285	13	352	791	11	56	0	0
8/10/2017	0	978	223	0	131	5	56	0	0
8/11/2017	0	968	124	0	66	18	191	0	0
8/12/2017	0	749	129	0	48	22	170	0	0
8/13/2017	0	1927	68	0	216	13	203	0	0
8/14/2017	0	765	127	0	171	14	52	0	0

Night	INDU	MISS	SACN	SLBE	PIRO	APIS	ISRO	GRPO	VOYA
8/15/2017	0	784	180	0	69	12	2	0	0
8/16/2017	0	1767	46	0	197	15	0	0	0
8/17/2017	0	468	111	0	145	23	0	0	0
8/18/2017	0	251	87	0	0	0	0	0	0
8/19/2017	0	164	159	0	0	0	0	0	0
8/20/2017	0	64	84	0	0	0	0	0	0
8/21/2017	0	94	218	0	0	0	0	0	0
8/22/2017	0	0	177	0	0	0	0	0	0
8/23/2017	0	0	159	0	0	0	0	0	0

Table 8-5. Number of Calls Per Deployment-Night Per Night (All Species Combined), for each Park (Figure 4-16)

Night	INDU	MISS	SACN	SLBE	PIRO	APIS	ISRO	GRPO	VOYA
5/30/2017	0	0	0	0	10	81.5	0	0	0
5/31/2017	0	0	0	12.3	6.7	136.1	0	0	0
6/1/2017	0	0	27.3	79.7	6.3	80.1	0	4.7	0
6/2/2017	0	0	62.3	28.2	3.8	4.2	0	3.5	0
6/3/2017	0	0	41.3	45.3	3.6	6.1	0	5	0
6/4/2017	0	0	52.3	24.8	4.4	7.3	0	3.9	0
6/5/2017	0	20.1	43.5	19.6	3.2	10.5	0	1.8	0
6/6/2017	0	15.4	27.5	35.3	0.2	15.3	0	1.1	0
6/7/2017	3.7	17.6	27.7	20.2	1.9	9	0	1.4	26.3
6/8/2017	13.4	14.4	30.8	21.5	1	8.3	0.4	0	40.7
6/9/2017	24.2	22.8	27.4	12.4	0.6	4	2.1	0	6
6/10/2017	22.3	22	21.7	49.1	4.4	26.8	4.6	0	32.3
6/11/2017	29.5	9.8	31.3	40.9	0.8	0.6	3.2	0	16.8
6/12/2017	30.6	42.1	15.6	0	1	8.2	1.8	1.8	21
6/13/2017	30.5	31.9	38.8	0	3	0.7	1.3	1.7	22.5
6/14/2017	25.1	49.3	41.6	0	1.9	2.3	1.7	0.4	35.3
6/15/2017	22.1	34.4	19.6	59.7	0.9	1.6	1.8	2.2	16.2
6/16/2017	21.2	26.2	35	76.4	2.1	3.2	0	1.4	19
6/17/2017	21.9	24.3	23	56.5	4.6	10.3	1.3	0.8	38.5
6/18/2017	23.6	27.9	21.2	51.8	0.3	7.9	3.7	0.5	33.3
6/19/2017	20.4	26.1	25.1	44.8	0.8	3.3	4.4	1	10.9
6/20/2017	12.3	18.7	35.4	17.2	0.6	4.9	2.8	4.9	4.1
6/21/2017	43.5	37.6	34.5	59.4	2.2	8	2.3	1.2	1.9
6/22/2017	53	21.9	41.4	41.7	1	10.5	3.3	4.8	4.3
6/23/2017	69.1	34.5	61.8	0	0.5	12.2	6.6	2.7	4.9
6/24/2017	57.7	21.2	55.8	0	0	3	4.1	0.8	1.2
6/25/2017	37.8	16.4	37.1	0	0.1	7.5	4.7	0	0.7
6/26/2017	26.7	26.3	60.7	1.3	0.4	7.4	5.7	1.2	1.1
6/27/2017	10.6	32	23.9	18.5	2.4	25.1	2.3	2.5	1.1
6/28/2017	42.1	80.5	51.1	14.8	5.6	0.6	0.3	0.9	0.2

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Night	INDU	MISS	SACN	SLBE	PIRO	APIS	ISRO	GRPO	VOYA
6/29/2017	40.2	43.6	3.1	18.8	1	0.1	0	1.4	2.3
6/30/2017	43.1	11.4	4.9	16	1.3	0.2	0.7	0.4	2.4
7/1/2017	48.4	12.8	9.7	10.5	9	0.1	2.1	0	2.1
7/2/2017	78.5	13.5	2.6	7.2	11.1	0.2	3	0	2.6
7/3/2017	28	21.5	4.1	5.7	1	0	5.4	0.7	2.3
7/4/2017	39.5	32.7	8.8	6	3.3	0.2	4.5	1.8	1.6
7/5/2017	56.6	26.2	8	7.5	6.8	21.2	3.9	2.1	1.3
7/6/2017	70.4	65	10.6	2	0	21.5	2.6	0.9	1.4
7/7/2017	48.7	35.7	0	0	0	7.6	1.7	1.9	1.3
7/8/2017	30.9	53.7	0	0	0	13.9	2.7	1.8	1.1
7/9/2017	120.6	41.2	0	0	0	19.6	3.4	1.6	0.8
7/10/2017	84.6	50.8	0	0	0	9.2	6	1.4	0.6
7/11/2017	86.8	76.1	0	20.5	0	6.7	6.7	1.1	1.5
7/12/2017	62.9	86.2	0	21.7	0.1	0.5	0.2	0	0.4
7/13/2017	62.2	29.3	5.2	10	0.1	8.7	0.1	12.4	0.8
7/14/2017	46.2	38.2	10.5	15.7	0.3	19.5	0.7	4	8.9
7/15/2017	88.1	61.1	11.3	21.4	0	52.8	0.6	5.3	6.7
7/16/2017	66	52.2	4.2	16.6	0	2.8	0.6	5.5	12.7
7/17/2017	53.9	30.6	9.6	29.4	0.1	1.4	0.9	2.4	16.2
7/18/2017	101.3	35.5	6	16.9	0.1	2.6	0.6	10.9	11.9
7/19/2017	87.2	31.3	8.1	0	25.6	5.7	0.2	11.7	13.8
7/20/2017	59.6	64.1	37.6	50.1	8.2	5.5	1.2	4.4	18.7
7/21/2017	18.3	67.5	40.2	63.6	6.8	11.4	1	8.1	3.7
7/22/2017	67	51.6	36	48.5	10.7	12.3	0.7	3.3	1.5
7/23/2017	99.5	27.4	45.8	45.8	0.3	8.9	1.5	4.5	2.8
7/24/2017	37.9	45.8	63.7	19.7	1.5	9.4	1.2	10.8	2.7
7/25/2017	65.4	50.6	60.7	64.2	3.9	11.1	0.5	17.2	0
7/26/2017	90.4	43.9	70.1	57.7	0.2	11.5	2.8	6.1	8.1
7/27/2017	66.6	6.7	14.2	46.5	1.1	13	0.3	13.5	5.6
7/28/2017	40.5	19.6	17.9	0	3	7.8	2.2	11.4	6.3
7/29/2017	54.3	15	18.2	0	4.8	23.7	1.2	16.5	8.9
7/30/2017	30.7	18.1	19.3	0	7	24.6	1.1	19.8	4.8
7/31/2017	42.8	18.1	22.2	0	7.5	11.9	3.6	22.3	7.6
8/1/2017	50.2	29.1	18.3	0	0.4	6.7	3.2	4.3	39.7
8/2/2017	39.4	27.7	7.7	26	0.4	23.2	1.1	3.2	6.8
8/3/2017	23.2	69	0.3	38.2	0.7	2.4	2.6	0	8.9
8/4/2017	38.1	25.5	4.6	22.8	0.7	2.1	0.7	0	3.5
8/5/2017	31.9	19	5.5	51.6	24.8	3.6	0.7	0	4.4
8/6/2017	27.5	33.3	5	33.3	13.6	1.4	0.2	0	3.7
8/7/2017	67	38.3	7.8	43.4	71	3.9	0.1	0	0
8/8/2017	24.1	58.1	10.7	43.6	28.8	0.8	3.7	0	0
8/9/2017	20.6	71.4	0.7	19.6	43.9	0.6	3.1	0	0
8/10/2017	0	69.9	15.9	0	9.4	0.4	4	0	0

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Night	INDU	MISS	SACN	SLBE	PIRO	APIS	ISRO	GRPO	VOYA
8/11/2017	0	69.1	8.9	0	4.7	1.3	13.6	0	0
8/12/2017	0	49.9	8.6	0	3.2	1.5	11.3	0	0
8/13/2017	0	128.5	4.5	0	14.4	0.9	13.5	0	0
8/14/2017	0	58.8	9.8	0	13.2	1.1	4	0	0
8/15/2017	0	65.3	15	0	5.8	1	0.2	0	0
8/16/2017	0	176.7	4.6	0	19.7	1.5	0	0	0
8/17/2017	0	58.5	13.9	0	18.1	2.9	0	0	0
8/18/2017	0	62.8	21.8	0	0	0	0	0	0
8/19/2017	0	54.7	53	0	0	0	0	0	0
8/20/2017	0	21.3	28	0	0	0	0	0	0
8/21/2017	0	31.3	72.7	0	0	0	0	0	0
8/22/2017	0	0	88.5	0	0	0	0	0	0
8/23/2017	0	0	79.5	0	0	0	0	0	0